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Computer Age

JANUARY 1981 ISSUE 14 60p

DOUGLAS R. HOFSTADTER

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Editorial

Acts of grace

Only a curmudgeon would now dispute *Computer Age*'s status as the premier computer magazine. And in turn it would be adamantine egotism not to acknowledge the help of many many people in making it so. In what follows I can mention only a very few of the many.

When we first started we discovered that *Computer Age* was a title already used by Honeywell for an inhouse publication. You can imagine what might have happened with its resources. Honeywell could have been as awkward as it pleased. Instead it showed grace (an old fashioned virtue, strongly in need of revival) and our title was safe.

I had wanted the *Brand News* section at the back of the magazine. Richard Ross Langley of Mine of Information recommended that it be in the centre, giving readers the option of a pull-out section. Mike Kusmirak of Equinox gave advice on the condensation and categorisation of press information.

Gil Filbey compelled our unique indexing of articles; for him, catchy titles were not informative enough. Professor Martin Healey, Dr Martin Beer, Martin Banks have provided a solid core, along with Dr Mike Fairhurst, Dr Darrel Ince and Richard Waller. In fact, had I the space I would simply list all our contributors and, alongside, the word 'thanks'.

Behind the scenes are the typesetters, the layout and design people (Gilfillan), production and printing, the staff of *Computer Age* and our publisher, who has kept to his promise of editorial independence.

Finally, our readers. Many articles and improvements are the results of their suggestions. As I've said before, it would at worst be disingenuous, at best fatuous, to say that every suggestion is taken up, but they are needed and welcome. As are readers' letters – the more the better.

Meyer N Soloman
Editor

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Brand News

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PEOPLE AND SYSTEMS

All flesh is grass. There is nothing new under the Sun. No man is an island. Power grows out of the barrel of a gun. These are sayings new and old reminding us that we are embedded in the world both making it and being made by it.

Sociology is the study of society at all levels, implying that sociology is thus the study of people and their social relationships. Sociologists study sets of related elements organized to some social purpose: at one extreme some sociologists study the set of related elements organized to form a nation state, at another extreme some sociologists study the set of related elements organized to form a conversation between two people. A key idea in sociology is that of 'system' (though it appears in many variants) and it is this idea of system which means that the use of computers in sociology can be so powerful.

Sociology has many detractors, and, as its nature is poorly understood, I am frequently asked what relevance computing has to sociology (and vice versa). I hope to show that computing and sociology mesh well, and I hope also to explain why some knowledge of sociology (and thus society) is an important benefit to those working with microcomputers.

Systematic Analysis

The idea of a 'system' is an important concept in the natural sciences, and may be defined as 'a group of related elements' (e.g. gas molecules in an enclosed volume). Some physical laws are systemic, e.g. Le Chatelier's Principle, 'If a constraint is applied to a system, the system reacts so as to minimize the effects of the constraint'. The way 'system' is used in sociology and other social sciences (plus biology, to a certain extent) is 'a group of related elements *organized for a purpose*', and the importance of the phrase 'organized for a purpose' is paramount. (As an example, this use of system is the basis of a systems analyst's work in computing, and the basis of language is also a group of elements organized for a purpose.)

We can distinguish between Sciences of the Natural, and Sciences of the Artificial, where by Artificial we mean Man-made. Society is made by Man, a computer is made by humans, language is man-made, and a conversation is made by individuals, between individuals, amongst other individuals. If Man had not existed, there would be no society, no computers, no languages and no conversations, but the Moon would still go around the earth.

Sociology, along with other artificial sciences, tries to find patterning and purpose in man-made systems: why is society so arranged?, what is the impact of technology?, why do computer people choose this machine rather than that?, and so on. It is easy to see that many other disciplines can overlap with sociology, which is one of its strengths – advertising firms have been known to ask for graduates in either Marketing or Sociology to work as Account Executives!

The Sociology of Microcomputers

Why are PETs so popular in the UK, but relatively less popular in the USA? What is likely to happen to 'Old' industries in the age of the silicon chip? How will we be affected by the ready access to information heralded by facilities such as Prestel? When will we see an end to Word Processing, because communication will be terminal-to-terminal rather than by paper missives? Where is the greatest impact going to be in the coming Age of Information?

These questions are ones some sociologists, and allied workers, are asking (as are the general public!), and – as sociology is concerned with the transmission of information between people – it is the subject best placed to try to answer such questions (which is not to say that others should not try). There are already precedents in sociology for all the questions I have just posed. Sociology of the 'diffusion of innovation' can help in the study of the unreasonable popularity of PETs, work in industrial sociology, and the sociology of work and organisations already gives us some basis upon which to base predictions. Some knowledge of sociology is an important element in an informed view of what microprocessor technology is capable of affecting in society. Will video games have as dramatic an effect on youth cultures as juke boxes and coffee bars did in the late '50's and early '60's?

I recently read an advertising brochure for one of the myriad of opportunistic 'business computing' firms – a study of the principals of 'business computing' firms would in itself be highly illuminating! This brochure was one that, if seen by the employees of any firm wishing to introduce microcomputers, would be the kiss of death to any peaceful introduction. The main selling points in this brochure were various, but three make interesting reading:

- **Make more profit**
- **Rely less on your book-keeping staff**
- **Need less staff**

If one wanted an industrial relations disaster, this one was ready-made.

Sociology using Microcomputers

Computers are greatly used in sociology for the analysis of statistical data, and for the teaching of statistics. Sociology shares this interest with most of the other social sciences, and it is worth remembering that BASIC was invented to help in the teaching of statistical computing to business studies/social science students. I want, however, to concentrate on a different dimension of use: how computers are being used to model social situations of many kinds. These modelling applications hinge generally on the concept of 'system' defined above, and sociology overlaps with fields such as operations research.

EXAMPLE 1

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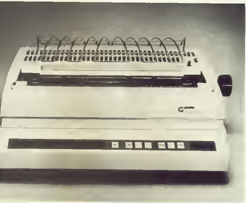

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ism will probably increase your dislike of me which will increase my antagonism which will increase your dislike which will increase my antagonism.

This syndrome is called deviance amplification in sociology, whereas it is called 'positive feedback' in systems theory, and if we have two groups (and not two individuals) we can partially explain why some deviant groups become more and more extreme in their behaviour. Society doesn't like delinquents so delinquents don't like society: the fact that delinquents don't like society, makes society like delinquents even less which means the delinquents like society even less which ... We can simulate (i e copy) this behaviour on a computer to find out what is going to happen over a period of time: we can even allow society to get bored with being annoyed with delinquents! Obviously this simple case can be the basis for far more complicated (and realistic) simulations.

EXAMPLE 2

One illuminating topic, and one for which many programs have been written, is that of the ecology of an area (a city, a world) given the constraints of finite resources. Finite resources lead to deprivation for some individuals which will affect their behaviour and their health (e g infant mortality and conscious restriction will lead to smaller families). These changes will then affect

depletion of the resources or substitution effects (e g coal for oil) will occur, and the cycle continues — though ever changing. This is a very good example of sociology, biology and environmental sciences meeting – with more than a touch of economics.

EXAMPLE 3

Society is composed of people and in the two previous examples we have only been concerned with the average behaviour of people like Han Seldon in the 'Foundation' trilogy (by Isaac Asimov) we are only predicting the probable behaviour of groups or worlds. Let us still be interested in the group, nation or world, but change the emphasis on how the individuals in the group behave, to produce the average behaviour.

What we do is set up a system with certain sets of rules, and patterns of behaviour and see what happens to the individuals in the simulation. The readers of the SF writer, Ursula K Le Guin, will be used to this setting up of a strange society with certain sets of social rules and charting the consequences of these rules. Ursula Le Guin has a background in social anthropology/sociology and her books exemplify this background – 'The Dispossessed' is not only exceedingly well written but it is also a highly sociological treatise on statism and anarchism.

Computer simulations have taken many forms. In the USA attempts have been made to simulate the voting of Congressmen, according to different sets of criteria, to see how alteration of the criteria affects voting. If it is postulated that the more often you interact with persons the more likely you are to like them (and the more you like them the more you wish to interact with them), we can set up a random group in the computer and let them interact, randomly at first and then later on the basis of liking, the idea being to study ways in which groups are formed. And, finally programs have been written to follow individuals through hypothetical cycles of deprivation to see what forms the cycles take – these are then referred back to actual cases to see where the differences are greatest between theory and fact.

Conclusions

I hope I have shown that sociology and microcomputing are intimately inter-related. Sociology uses the computer as a tool, and also in sociology we study what the place of the microprocessor is in the world of today and tomorrow. ■

• Dr Boris Allan is at the School of Sociology, Department of Social Science, the Manchester Polytechnic.

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Letter from America

Peter Krass

The Patter of Tiny Chips

• *This newsletter is by arrangement with Technology News of America*

'America is the land where the machine is an intimate part of our fantasy life This is the land of the kandy kolor hot rod the Hell's Angel chopper the drive in movie

Once again, history is proving Ted Nelson right

Back in 1974, Nelson published a wild whirlwind of a book, *Computer Lib/Dream Machines* a sort of *Whole Earth Catalog* for computer use The book has been called many things a work of genius the ravings of a madman the musings of a dreamer It is also the source of this month's opening quote

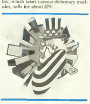
Even if nothing else has happened on the American computer scene since Nelson published his opus, the advent of the talking microchip would prove that at least some of what he had to say made sense The speech chip is straight out of science fiction. But make no mistake about it it's real

Talking chips also known as speech synthesis circuits can be used in some unsettling ways For example in elevators You walk into a talking chip-equipped elevator A disembodied voice suddenly calls out Going up! You can t be blamed if, next time you consider using the stairs

Or let's say you re running your latest progam through your trusty micro (cleverly equipped with a speech chip) It s a new program and, of course, there are a few bugs Problem is every time the system snags your computer says something like 'You blew it again, Pete You may quite justifiably, decide to get involved in something a little less intimidating, a bottle of Wild Turkey or something like that

At any rate your fears may not mean much in the long run Talking chips have been around for a few years, and their use is beginning to take off in the US Those of us who find their use a bit alarming are probably just going to have to adjust Certainly, companies like Texas Instruments and National Semiconductor two current market leaders, are going to do all they can to fill the world, or at least some percentage of it, with talking machines

TI now sells a number of consumer products which employ voice chips The company has been hard at work on speech synthesis for about 10 years and it introduced its first talking product the Speak and Spell in 1978 This hand held toy, which takes various dictionary modules, sells for about $75



Other TI consumer products that talk include the Speak and Read ($95) the Speak and Math ($85) a synthesizer module for the company's 99/4 personal computer ($125) and the Language Tutor ($200 for one language an additional $60 for other plug in modules)

The company also sells two industry products the TI 990/306 industrial speech module, and single speech chips The module is actually a computer board for single-board computers it uses eight 16K erasable programmable read only memory chips (EPROMs) and costs $1,250 The chips, which TI is selling to OEMs, cost $13 each when ordered in large quantities (See Micro Voices', Issue 12 **Editor)**

TI s speech chip technology uses what is called **linear predictive coding**, a technique TI developed in 1976 This label is a product of what it identifies linear equations are used to create a mathematical model of the human voice tract and to predict a speech sample based on previous samples Another way of putting it is that a digital model of speech production is constructed In effect, the model mimics the speech process

This requires 200,000 additions and multiplications per second – meaning that TI talking chips use about 1K bits of memory per second a quantity the company describes as 'modest ' This in turn produces some 200 speech samples every 20–25 milliseconds The digital signals are then converted to an analog signal which drives a speaker

National Semiconductor, the other major U S presence in the speech chip game, is marketing an integrated circuit (IC) it calls the Digitalker This IC uses a technology called **waveform digitization** in which speech waves are sampled digitized and compressed They are then stored in the Digitalker s read-only memory (ROM) Current memory requirements for waveform digitization are between 400 and 2 000 bits per second, depending on desired quality

Nat Semi, as the company is known

within the industry is selling the Digitalker for between $10 and $20 each, depending on order size Typical buyers are manufacturers of automobiles appliances, toys and games, companies that buy thousands of chips at a time

Nat Semi has suggested some possible uses for its Digitalker They include installation in cash registers, test instruments, word processors, farm machinery, calculators and vending machines The company believes the market will be quite big it forecasts $700 million in revenues from sales of talking products by 1985 $250 million of it for the major corporations and $450 million for the industrial OEMs

TI is equally optimistic predicting a $3 billion worldwide market for speech chips by the end of the decade

While there is little question that, before long, most microcomputers will employ speech or sound chips (many already do), it seems that most of these millions or billions of dollars worth of chips will be used in industrial applications

According to James Mendelson, who watches the semi conductor industry for New York stock brokerage Morgan Stanley, the major use for speech chips will be in sophisticated industrial settings, such as computer rooms jet cockpits and cars and trucks Although the use of speech chips in consumer products will attract the lion's share of attention Mendelson points out, they won't represent that much of the business Rather than hoping someone will glance over at a dial or light on a console speech chips can alert the operator to a problem ' he explains, and that's where they're really useful '

So it is likely that the operators of, say, the control room of a nuclear power plant, will someday hear a still, small voice alerting them to meltdown, meltdown

In the meantime computer hobbyists here in the US are wasting no time exploring the talking chip's possibilities The results aren't all in yet, but it seems that it may very well be hobbyists who discover some yet-unrealized applications And Ted Nelson is surely keeping an eye on things ■

•*See also David Sands article this issue*

National Semi's Speech Processor Set™
National Semiconductor Corporation has introduced a system for digital storage and reproduction of human speech Designated Speech Processor Set (SPS™) it is designed to interface easily with most microprocessors and is useful in a wide variety of industrial and consumer applications

The Speech Processor Set™ is a kit of several N-channel MOS Integrated Circuits comprising a Speech Processor Chip (SPC) and one or several speech Read Only Memories (ROM) which with simple external filter audio amplifier and loudspeaker produce high quality speech Male female and children's voices in most languages can be produced with this technique

The technique used by National's SPS™ is waveform digitisation and compression The technique minimises the cost of the logic hardware and memory With a compression algorithm, the amount of memory needed can be reduced significantly

Using these techniques speech is not only intelligible it is also recognisable Because the stored digitised speech originates from a recorded human voice the reproduced speech contains all the accents inflexions and nuances of the original Typically a male voice requires about 1200 bits per word of speech Because of the higher frequency content female voice synthesis requires a higher number of bits per word

In operation the speech processor chip communicates with the speech ROM which contains the compressed speech as well as the frequency and amplitude data needed for speech output. Up to 128K bits of memory can be accessed directly i e some 100 words of male speech

Among the features of National's Speech Processor Set are *256 possible addressable expressions *TTL and MICROBUS™ compatibility *on-chip switch debounce for interfacing to manual switches *interrupt capability for cascading words or phrases *crystal-controlled or externally driven oscillator

Only custom vocabulary chip sets will be available initially ■

A National Semiconductor news release

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THE VIEW FROM WEST BERLIN

Eckhard Fuchs chairman IKD 80

How is West Germany coping with computerisation? As low-cost micro-processor power puts automation within the grasp of more and more people how are they handling their technological and social problems? Do the Germans have problems? The International Congress Centre in West Berlin was the venue of the IKD 80 International Data Processing Congress. By listening to speakers at the congress and from an interview with **Eckhard Fuchs** *director of data processing for West Berlin and chairman of IKD we can have an insight into the way the Central Europeans are facing up to the computer age and how they see themselves in the world*

Of the western industrialised nations it is America that leads in computing technology But had history taken a different turn it might have been Germany out in front today

In the early days of the Second World War Conrad Zuse built what was probably the world s first real computer He built it in conjunction with another electronics enthusiast he met whilst they were both working on a stage version of *King Kong*

Zuse took his computer to the government but Hitler incorrectly believed that as the war was going to be over soon there was not a lot of point in developing it Meanwhile Britain went ahead with its own Colossus code breaking computer which helped to beat the Germans After the war Germany s economy was shattered Its occupation by the Allied Powers followed by the partitioning of the country and dividing and isolating of the capital Berlin, all meant that Germany had to come from a long way back in the climb to postwar prosperity Consequently it was a late starter in the computer race

Today it is obvious that Germany has taken giant steps up the computing ladder Once the technology gap between it and the U S was estimated as 5 years New developments happen so fast in computers that this time gap was considerably larger than had it been in any other technological field Now according to Eckhard Fuchs, the size of the difference is blurred because the Central Europeans have made more progress on some things than others Where Germany has done particularly well is in laser technology, cable television, (which could be used for interactive computer services) and minicomputers

The spearhead of the minicomputer attack is Nixdorf Computers "Their impact on the American computer market can be likened to the impact of the Volkswagen Beetle on the American motor car market" says Fuchs

> *'It does appear that Great Britain and West Germany have very similar experiences in the adoption of the new technology.'*

Interestingly it is the computer related problems that they are facing that give the real indication of the progress they have made The advent of the low-cost microprocessor and its rapid adoption by all spheres of industry is leading to the twin evils of rising unemployment coupled with a desperate shortage of skilled d p staff On the plus side, the increased use of computers has improved productivity for their already advanced industry To be sure German unemployment figures are not so high as ours (about 800 000 registered unemployed last October) but that has more to do with the philosophies and policies of the respective governments than with new technology

One conference session at IKD 80 was "Computers and the World of Work' At this one of the speakers was from the German equivalent of the T U C , who talked of the research done by that organisation on the impact of the microprocessor The conclusions drawn are frightening Over the next five years they estimate that 5 million non-computer office jobs will be affected by the installation of computers and word-processors some will be changed others will disappear This, coupled with the coming world recession will lead according to a German government study, to total unemployment figures of 3 94 million (1 65 million registered) by 1985 falling to 3 06 million (1 2 million registered) by 1990 Although the total number of jobs will not fall greatly the German labour force will increase by 900 000 by 1985 the increase falling to 450 000 up to 1990 The lower figures are due to the falling birth rate rather than the discovery of a magic formula by the politicians

Such a large number of unemployed people especially young school leavers short of money discontented and bored is a serious threat to law and order and democracy The final session of the conference dealt with just that It was by a computer science lecturer from Brunel University Robert Parslow, entitled Can Democracy Survive Technology?'

He pointed out that growing unemployment leads to increased violence, particularly by the young As the economic difficulties in Britain are so complex Parslow says, the response of the government has been to treat the symptoms not the cause, by strengthening the police and armed forces He estimates that there will be well over 4 million unemployed in Britain by 1984 Parslow s bleak conclusion is— 'The evidence of history shows that these conditions foster war or revolution but my prediction is that this time they will drive our government to assume totalitarian powers we can now only fortify our buildings and hope to ride out the storm Parslow predicted a similar crisis in Germany in the later parts of the 1980 s You know the dreadful results of high unemployment and economic recession , Parslow told his mainly German audience 'You have more time than us to take action to avoid the dangers facing Britain

Parslow's belief was echoed by a German union leader, Eberhard Fehrman, who said he expected that Germany's better economic and industrial relations record will enable it to make a soft landing in the potentially troubled 80's He wants to have technology agreements similar to those proposed by the British T U C But Fehrman knows that the best technology agreements in the world will not re-create jobs that no longer exist and that the Germans need a new attitude to work and leisure

Although Germany has its own computer companies – Siemens (*see panel*) which has a factory in West Berlin, and Nixdorf – it is the American giant IBM, that dominates the market Fuchs would like to see more European computers sold in Germany He uses an ICL system, he likes ICL equipment and is sorry that the chance they had in the mid seventies to boost their sales in West Germany came to nothing It was not ICL alone that tried to grab a bigger stake in West German computing About six years ago there was an attempt to form a single European computer company which could face up to the American challenge The idea was that four European manufacturers should all come together They were our own ICL, France's CII Germany's Siemens and the Dutch Philips ICL however decided not to join in and to go it alone leaving the other three to form a company called Unidata

Together they would have had a huge range of equipment to sell and all working together instead of against each other would have been formidable – or should have been The truth was that it did not work ICL carried on with developing its own 2900 range, and the national corporate differences could not be resolved within Unidata IBM continued to dominate and now have a comfortable 60% of the West German market But Fuchs still feels that co-operation between nations particularly Britain and West Germany,

Germany

is the key to more European sales within Europe

Getting the software right is causing more than a few headaches on big and small systems Not just a Central European problem that it is depressingly familiar to British ears Over the last few years the hardware has become much cheaper to build and buy One German mail-order house has a home computer for sale in its catalogue Software on the other hand is becoming more expensive to produce It is no good expecting the software written for the old machines to work on the new ones it simply is not efficient enough

Eckhard Fuchs put it this way, You just can't take the engine from a 1960 car and put it in a 1980 car and expect the same results He would like a European standard in software Co-operation is the key, but at the moment We are all inventing the wheel over again The result is that many small companies are installing small business computers and finding that they do not work Not because the hardware is wrong he says, as most hardware does more or less the same things But if the software is not written with the individualities of the user in mind the computer will cause more problems than it solves At one conference session on software there was a call for a network by users By sharing the difficulties there will be a greater chance of finding some answers

International Congress Centre

The software problem is agravated by the shortage of trained d p staff Training programmes cannot keep up with the rate of German computerisation The 4 000 newly trained people who will come on to the market next year are not expected to be enough to meet the real need

It does appear that Great Britain and West Germany have very similar experiences in the adoption of the new technology More dialogue between the two would surely prove beneficial Information technology is one technology that should unite the nations Berlin is a divided city alienated from its own country by a wall A Berliner knows the need to bring people together Nobody is saying that talking about computers is going to bring world peace but it is something we can all talk about Every national has a contribution to make in this newest of technological developments International get-togethers could benefit everybody

The conference centre in West Berlin is ideally placed to be the venue of such international congresses that bring together East and West and North and South Here they would have an opportunity to discuss not only technological developments but also the social aspects and how the industrialised countries can best help the developing countries ■

Siemens Mission

The last best hope of the European chip business would appear to be Siemens which should sell roughly $450 million worth of semiconductors this year Though it also makes a lot of chips for consumer products, the company is strong in engineering applications and is thought to have the most advanced metal oxide technology in Europe Siemens has bought interests in five U S semiconductor companies – including 20% of Advanced Micro Devices – to keep abreast of the market find outlets for its technology and complement its product line It is the only European company that is producing a 16 000-bit computer memory chip the current world standard it plans to churn out three million of them this year giving it a place in the international top dozen

By 1981 the company expects to be making a 64 000-bit chip the next world standard Friedrich Baur who is credited with turning around Siemens's components activities over the last five years is determined to pull it off 'We haven't yet been the first to establish a standard integrated circuit' he says 'But it is a certainty that we will be

Unlike most European firms Siemens has learned to avoid the pitfalls of vertical integration 'It is a mistake to let inhouse pull dominate your components production says Helmut Schwab vice president of the company's U S components group "We did it once and we won't let it happen again Siemens realizes it must offer outside customers more than surplus chips first designed for its own needs Like Intel Motorola and other U S makers it is moving to expand its markets by adding software and microelectronic extras to its chips transforming them into complete systems for solving the customer's problems

▪*From* **Fortune** *magazine July 28 1980 Article titled Europe's Doomed Attack on Silicon Valley*

• *Penny Flood is the Applications Correspondent of Computer Age*

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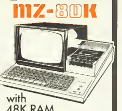

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The First On-line Society?

The global village may always be just over the horizon, but France is turning itself into a national village

What do you do about Granny? There she sits, all alone in the house, and nobody within shouting distance. Not that she would forget her dignity and shout.

Company is only a phone call away. But she is going to have to use this *thing*, this TV-like small box, with its more than fifty keys, that sits next to the phone. Though Granny is proud, and won't phone her daughter-in-law whose number she knows, she desperately needs the telephone number of her first cousin. She cannot remember it, for her memory is not what it was; the number is not in her diary. And there is no printed directory anymore.

Granny, like many old people, regards all this advanced technology with grave suspicion. But she still needs that phone number. And all she has available is this VDU. *Somewhere* in there, or *through* there, or *something*, is the phone number. How is she to get it?

Now there's seven year old Jean Paul. He wants the number of one of his friends. He can read, but only just. And he too doesn't want help, desperately doesn't want help. He can do it on his own, thank you, without aid of fathers, mothers, sisters. He's not afraid of it, he will quite happily press every button in sight. And he does.

Those are two extreme possible cases. If you take all grannies and all small children old enough to press the keys, you get probably around twenty per cent of the French population. It is a twenty per cent that has to be catered for—you have no option.

For you are building a national system, one which is meant to become as all pervasive as electricity or the water supply. It is to be the first port of call for telephone information.

But not everybody has the telephone. That is something the French are trying to change. They are in the throes of the most massive capital investment programme ever undertaken by a national authority in France, indeed one of the most massive such programmes ever undertaken anywhere – currently at between two and two and a half thousand million pounds a year. Indeed, within twelve years they expect that well over 90% of French households and businesses will have been connected up. Nobody is so unrealistic as to expect a 100% success.

To treble the phone population in ten to twelve years, for that is what this means, would be a massive task at the best of times, the best of times being a period of technological stability. But they, like the rest of us, are facing a technology changing rapidly and radically. And unlike the rest of us, the French PTT and the establishment that supports it have eagerly—some say, too eagerly—grasped the possibilities.

Take the rationale behind the electronic directory system, or, as the French call it, the Annuaire Electronique. This is not an attempt to do something technological for technology's sake. True, in France more than in most countries, the technologists are in charge, but this elite also have the educational background for some knowledge of economics. And the Annuaire is rooted in economic reality.

That reality is this: every time you double the size of the phone population, you put up the costs of directory services fourfold. Those increased costs come in various ways. There is the additional cost of printing and distributing directories and there is the additional cost of providing directory services.

You do not just put up the cost of the directories, you also heavily increase the operational load. The French PTT's calculations are that, at the current rate of phone build-up, and without changing the frequency with which the phone directories are printed, the subscriber is faced with, as a minimum, at least a third of the entries in the directory being either wrong or absent. Which is no way to run a system.

Of course, you have the sharp difference that directory enquiries are not a free service: the user pays for each enquiry made. But it does not take much wit to see that this is no way to leave users satisfied. Chaos, always imminent, could take over.

Set in this framework, then, a radical solution such as giving each subscriber a cheap VDU and organising an automated directory service is not quite as visionary as it might seem, particularly, and this is where it begins to become complicated, when there are other service possibilities appearing, possibilities which could be, and are going to be, incorporated.

Take mass market information retrieval. While the French PTT has been working out what to do about the telephone directory, it has also been looking at a Prestel-like service, the provision of information to the home via the telephone and a home terminal.

And that is not all. The country, at least its decision-making elite, has been struggling with the question of the future of society in an era of mass electronics and information dependency. The medium and the message may be an old one from the sixties, nevertheless it poses quite fundamental questions about the nature of society, how people are to be trained, what they are to be trained for, what are they going to do with their lives.

Those questions have been addressed by the French in many ways. Perhaps the best known internationally was the publication of L'Informatisation de la Societe. This was the report, commissioned by the President of the Republic, on computerisation and society.

All this public discussion, debate, government and government-department initiatives have had a great impact on the decision making elites of France. To put it crudely, almost everybody can see that there's going to be some action and they want a piece of it. Thus, if you go back to the development of the Annuaire Electronique for a minute.

CAP Gemini Sogeti, the large French software house, are in charge of the Annuaire's software development and of the trials that are to begin in 1981/82. The main trial, that is, between 250 and 300 thousand terminals put out to subscribers in the Rennes area.

Shortly after they obtained the contract, they held a conference to show what they were up to and the scope and breadth of the services which would result. And, as ever, they sent out more invitations than they expected attendees. But not only did most people invited turn up, many brought others with them and there were hundreds of people milling around the Hotel Meurice in Paris. I know, I was one of them.

Now, come back to that Prestel-like service known as *Teletel*. It is best thought of as Prestel plus, for those French elites have measured the dimensions of a mass-market electronic communication and information-providing system.

One cannot stress too much that France is both a centrally run country, and yet a country of individualism. General de Gaulle once put it, "How can you run a country which has over 500 cheeses?" It is a problem which has been actively grappled with, though the solution might not find favour elsewhere. The men, and they are all men, who run its major government and private enterprises all have the same or very similar backgrounds. France is run by the largest old-boy network anywhere. And its members change from public to private employment and back again without a qualm, without career or pension difficulties. That's the way the French game is played.

The result is that if the 'establishment' in government decides to go in a particular direction, it has done so in collaboration with its opposite numbers outside, and everybody marches in step. Or as much in step as could be expected after all, it is still France.

So the "social" administrative bodies are keen supporters of the information provision services. One of the first banks of data to go up will be that recently devised and codified French administration guide to citizens' rights *vis a vis* the machinery of the State.

French Railways, too, are keen supporters of the information provision service; they see it as a good way of providing timetable data. This is also a use that Prestel in the UK is to be put to—so, what is the difference? The difference is the level of management involvement; in France it goes to the top.

The Teletel service is also to be given a trial. 3500 to 4000 sets supported by a wide range of services are to go into a suburb of Paris in 1981. The trial will offer the usual range of Prestel-style information. However, it will also contain experiments, supported by the major banks, which will enable the user to deal on-line with his bank, look at his position, and carry out on-line transactions, make payments and generally act as if the person was dealing with the bank in person and not just electronically.

The key to this of course is communications. And here, this is where French conceptual thinking has come into its own. They have grasped the key fact that what we are really talking about are communications services, and that all the other uses ride on the back of that.

It took some time for this to filter through. The French have their share of obscurantists, people who determinedly will not see the point because seeing it means that they will have to change. But the society is geared to overcoming them. For a time the PTT determinedly tried to ignore the likely impact of these services on its postal message traffic. But French logic came to their rescue, even if even now they publicly soft-pedal the social impact on the postal system.

This does not mean that they have as yet anywhere near clearly worked out what the full range of communications services will be, and when these will be offered, though there will be a message service for trial subscribers. Among the reasons they have not worked it out in full is that the future shape of the services will in part be determined by how three other sets of experiments and trials are received.

Firstly, there is the French version of broadcast Teletext, their equivalent to ITV's Oracle and the BBC's Ceefax. They have already mounted weather, stock exchange, and road traffic conditions experiments in Paris, Lyons and Marseilles.

They are due to increase the capacity and geographical coverage of this system, make it truly national, and then make it accessible not simply by broadcast but also over telephone lines.

'How can you run a country which has over 500 cheeses?'
'France is run by the largest old-boy network anywhere.'

Secondly, they are making a genuine attempt to discover if it is economically possible to go for local telephone distribution systems based on fibre optics. This of course would give users almost unlimited local transmission/receive capability. They are not fiddling it, as almost everybody else has done, by taking a new, purpose-built, community. Instead, they are going into Biarritz, a mixture of old and new property.

Thirdly, enter the cheap fax device, a facsimile transceiver which is also a standalone copier. The PTT is to market those at around £200 each, and may well also rent them out. Eventually they hope to have a version which can be coupled to the Directory terminal for hard-copy output.

Excluding initially the facsimile machine, all other services will run on that Annuaire Electronique terminal which the user will receive included in his rental. And it does not follow that everything else will have to be rented from the PTT. The current line is very flexible indeed. For many months past, the Minister in charge of the PTT has been addressing meetings around the country saying something which, simply, runs like this:

'We are in the business of providing communications and network services. If you want to stick things on them, go ahead. It is the network which is the natural monopoly, not the rest of the services."

Indeed, talking to businessmen, he has pitched it even stronger: "We have the network, why don't you make more use of it? If you want to provide third party services which add to your income, do so. We shall cooperate. After all, if there is something in it for you, there will also be something in it for us. The real business of the PTT is providing telecommunications.'

And so I return to Granny and to Jean Paul. It is not even possible to ask what is in it for them. Of course, what should be in it for them should be better, that is, more accurate and fuller up-to-date, information more quickly and without any great expenditure. And this should lead to wider horizons.

But before that, there are some major hurdles to be jumped. I am not talking of the usual hurdles which come in the way of any major national system, the time when only a part of it is actually up and running and such is the cussedness of things you can be sure that, whatever it is you want to do, the system will not allow because it is not yet installed there. What I am discussing is something much more fundamental.

It has become a cliché in and around the computer industry to talk of user-friendly systems. To make systems behave as such is a plus point in any good marketing strategy. But most computer systems—I exclude those of the hackers and hobbyists—are still sold and bought for good economic reasons. And the users are prepared to go through a learning process to get the best they can out of them.

We are not dealing with that situation. The situation that the French have to cope with means that they will be the first to seriously tackle the problems of taking a whole society "on line". It is in many ways a fundamental change as happened in the last century when education in the major industrialised countries became available to all.

And the key problem in that change is going to be the devising of—would you believe—the user interface. Just think of Granny. She is faced with an alphanumeric keyboard. Well, she can cope with the alphabet, and she can cope with one to zero. But what about the function keys? Narrow down to the Annuaire Electronique for a minute. Let us assume that all the numbers she is likely to want to access are in the system. Her only problem now is to access it.

First, it must clearly say "switch on". Then it must immediately ask you what service you want and tell you what to do next. Even though we are only dealing with the directory service at this stage, one must immediately be able to differentiate one service from another. The user is not that motivated to fiddle around.

Which takes us to the function keys.

Obviously you need go forward a frame and go back a frame And you need a cancel button so that when you get in a mess you can get out of it by going back to square one and beginning again

You also need a panic button, an override This is particularly so in the case of a first generation of users when you take the population as it is, not as perhaps the designers would wish it was basically trained to handle electronic systems because it grew up with them

But when do you allow the panic button to be used? It is not that odd a question If your initial routines are too complex if the system's instructions on how it should be operated are not clear enough or carry ambiguity then users will start pressing the panic button soon And if they do that, then a large part of the rationale for going electronic disappears People switch to the manual override use the panic button and call the human operator And you are back with huge telephone directory enquiry staff again

Even if these questions have been satisfactorily answered you still face a problem You have one set of function keys on that VDU You cannot allow the keys to serve different functions according to the service they are dealing with Go forward one frame must be *go forward one frame* irrespective of the service the user is accessing Any other system would confuse

France

So having gone through guides which tell you how to use the system and having arrived at a point where you can receive actual information what does the system provide?

Well, the directory allows for two types of searches One is called general, the other professional though both will be available to all There is one other differentiation The output will vary according to whether the user is in a small community or a large one

In the small community a general search will generate all the names, addresses and telephone numbers under a particular name Thus, say it will list out all the Duchamps with their initials and addresses though if you did know the initial and address you could go in directly

The same search carried out in a larger town will allow the single name option, or else will allow the user to look at the addresses of all the Duchamps in a given area, allowing say, a look at all those who may be in a particular postal district or even in a street

One does not have to know the address The professional search will allow the user to seek a phone number for a given name according to profession It is not limited to a search for a doctor or lawyer but allows for company names and other trades and occupations It is a sort of electronic flexible yellow pages

And, like the yellow pages, it allows for advertising After say the Duchamps Brothers can come a frame in which they advertise their wares The system allows the Duchamps Brothers to be got at in another way There will be provision for searches which begin with a trademark and end with the name address and phone number of the manufacturer or local or other distributor

But what happens if you are not sure how the name is spelt? The system allows for that, too There will be a name thesaurus which will give all possible spellings of a name and will then allow the user to enter in the normal way via any spelling that seems likely

All I have done so far is scrape the surface of the most complex yet concerted approach to providing the mass market place with the sort of electronic services that the best of businesses of which there are as yet precious few, enjoy

I watch with fascination as the French grapple with problems which to most of us are new And at the back of my mind, I keep on remembering that the unofficial motto of the best run organisations in this industry seems to be 'It pays to be second' I only hope they are wrong ■

● *Rex Malik is one of the pioneers of computer journalism in Europe*

CODIFIED COMPUTER SYSTEMS

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In delightful Milton Keynes [illegible] ful Buckinghamshire a near genius who sleeps too [illegible] smokes too much realised the obvious and designed the following set of S100 cards to IEEE timing specs The brand is *Interective* The cards work well and we regret that not only is the chip count low (giving greater reliability and proving good design) but also there are no cut tracks or free soldered wire jumpers

Z80 CPU	S100 4 MHz CPU card with remarkably few chips A & T £105 00
FDC	1791 (not unnecessarily DMA) floppy disc controller to handle any combination of 8" or 5" drives at single or double density A & T £158 00
16K SRAM	16K static RAM card using 2114 s (we look forward to the Mark II with 24 bit addressing) A & T £198 00
SMBC	An S100 single board computer with Z80A 1K RAM up to 16K ROM 2 RS232 (or 20mA) serial I/O and 4 channel counter/timer/vector interrupt A & T £235 00
PCI	Process control interface D/A A/D 8 channels output relay isolated input opto isolated A & T £235 00
PS	Complete S100 power supply on a card (12 amps @ 8 volts) plus power for any two drives A & T £155 00

[illegible]

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Contains two DRI (made in Crewe) 7200 double-sided 8" drives giving 1 6mbytes at double density There is room for two more inside It is made of wood (genuine chipboard faced in oak veneer) by dedicated British workmen in Tottenham and finished in tough acrylic varnish It is supplied with 50 way connector power supply and lead mains filter (of course) illuminated on/off switch fuses and large fan to BS3456 Price £1 150 00

3 Systems, Software, Peripherals, Advice and Consultancy

A complete CP/M (TM Digital Research) operated system based upon these components with 8 DS DD Disc storage VDU and printer will cost about £4 200 We can reduce the price by taking off luxuries e g reducing the disc capacity Example – the Polaris Skyline system (made in the UK) 32k would cost £1 925 with discs

Business software and a fine word processing system is available (written in Yorkshire) for those who need a simple but expandable solution to their problems CODASYL standard database software is now available and an electronic mail package is imminent

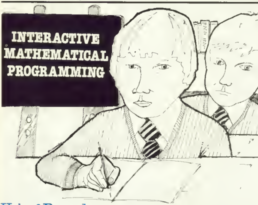
Consultancy on matters to which we can claim expertise is available In order to eliminate bias we must refuse to sell our products to a client for a year if in our opinion as consultants Interactive based systems fit the requirements they will have to be bought from another dealer

The DAI personal computer with its unparalleled graphics facility at £900 is held in stock Ring us to arrange a demonstration

[illegible]

Computer Aided Teaching | **Queen's University** | **A. W. Wickstead**

INTERACTIVE MATHEMATICAL PROGRAMMING



Using Pascal

The author discusses developments at his University and points out the dangers of the proliferation of educational software that has no limited standardisation

In this article I would like to recount some of the experiences we have had in the Pure Mathematics department at the Queen's University of Belfast in developing the classroom teaching potential of a microcomputer. In our case it was an ITT 2020, but hopefully many of the lessons we have learnt will be of interest to educational users of other machines, at other levels and, to some extent, in other subject areas.

When we purchased an ITT 2020 late in 1979, we were interested in it as a tool to be used in front of a class, as a supplement to the more traditional teaching aids of blackboard, overhead projector and duplicated handout. So far we have not investigated its potential for Computer Aided Learning (CAL) in the sense of a one-to-one relationship between a student and a microcomputer. There are possibilities for future development in this area, especially for remedial teaching, but this is more likely to take place through terminals linked to one of the University's mainframe computers. As a front-of-the-classroom teaching aid the portability of a microcomputer is essential, but that would not be needed for CAL use.

The possible uses that we had in mind were the ability to produce accurate pictures and to do calculations associated with them in the classroom. One advantage that was not so clearly foreseen, but which has turned out to be one of the most important, is the ability to allow the class to interact with the demonstration. After seeing some examples chosen by the teacher the class can be given the opportunity to see that examples *they* choose also work, and that the teacher has not just chosen simple examples that work (students can be suspicious, especially the better ones). Once emotionally convinced of the probable truth of some assertion it is far easier to force oneself to put the effort required into mastering a formal proof. For this kind of teaching to succeed, a microcomputer seems essential, at least if graphics or complicated calculations are involved.

'Great programming care is needed with input from and output to the user.'

We are not in the business of teaching statistics or dynamics, where the potential of a microcomputer is obvious, but in that of teaching basic mathematical concepts like differentiation, convergence of sequences, etc. The microcomputer cannot teach any of the proofs involved here, at least, not as we are using it, but it can get across the basic definitions by illustrating them graphically. Thus we need to produce visually convincing graphics rather than do precise numerical calculations. The limited precision of APPLE Pascal's real arithmetic is no bother to us, the fact that on the ITT 2020 it does not plot lines of length 2 correctly is. We need to produce graphs that look right — lines should be solid and not dotted, and jumps should occur only when they are needed (and *should* occur then). The problem is much more that of putting on a show than of typical scientific computing.

Our decision to purchase an ITT 2020 was governed by the desire to have a machine with good resolution graphics and which also had local dealer support. Our initial purchase included one disk drive and a full complement of 48K of random access memory. We ordered an APPLE language card in order to run Pascal, although it was not immediately available. After seeing this demonstrated it became obvious that a second disk drive was essential. Not only is a single drive system inconvenient to operate but it also limits severely the size of program that can be compiled (APPLE Pascal programs can consist of up to 7 segments, including one permanently resident and so can be quite large)

At present we use a 9" monitor for the lecturer and a 12' monitor for the class This has proved adequate for demonstrating *graphics* to a small class (about a dozen students) but more and larger monitors will be needed for bigger classes even with graphics It does not seem worth trying to put text across, apart from writing large characters on the graphics page Both monitors are black and white The colour output to a domestic TV is disappointing, and even with a dedicated colour monitor it is only satisfactory for large areas of colour A sine curve, for example, is multi-coloured (if drawn in white, dotted if drawn in red/green) unless all points are duplicated by the point to one side, which effectively halves the horizontal resolution

After initial experiments proved promising and it had become obvious that program development time had to be cut we purchased a printer to list programs It has also proved useful for monitoring the output of programs and for tracing the operation of programs running in graphics mode

If our expectations of a microcomputer are to be justified it is essential to make it part of the teaching repertoire of *all* our teaching staff, not just of a few who can program it It is therefore essential that programs should be as easy to use as possible One should certainly not expect the user to understand how to alter programs or change operating systems, and all output and input should be in plain language Few appropriate programs appear to be readily available either commercially or from existing programs on University mainframe installations What is available that might be adapted is marred by the demands it makes on the user So we decided we had to develop our own software

In common with most educational users all our programming is done by members of the teaching staff in addition to their normal duties of teaching, administration and research Program development time must therefore be cut as much as possible When our system was purchased Pascal was not immediately available and even when we did get it proper TURTLEGRAPHICS (the high resolution graphics output) was not available for the ITT 2020 for several months (it employs 9 bit bytes to store graphics, which gives better resolution than the APPLE, but the 9 th bit requires special access) Our initial programming attempts were therefore, in PALSOFT BASIC We wrote and tested in the classroom a general purpose graph-drawing program one to illustrate the definition of the Riemann integral and a third to demonstrate the uniform approximation of continuous functions by polynomials Although they were successful both in that they worked and were well-received in the classroom, it was clear that program development needed to be speeded

It seemed likely to us that the structured nature of Pascal was likely to improve the progress of program development The combination of using Pascal and a printer certainly has cut development time dramatically, especially the time actually spent on the machine – vital when several people use one microcomputer The nature of the language is such that much more time must be spent designing the program before getting near a machine, but getting from that stage to a running program is much quicker Typing errors can be eliminated in a single pass by using the quiet compilation operation (* $ Q + *), and sending the output listing to a printer This option continues compilation after errors, so all can be corrected at the end of the run In theory, at least the listing could be set to a disk file and then studied later but, in practice, it is not possible to accommodate the text, code and listed versions of a large program on a two-disk system. Between them these two factors cut down time spent on the machine and mean that much work can be done away from the machine in odd moments

'The combination of using Pascal and a printer certainly has cut development time dramatically '

One advantage of BASIC in writing programs for mathematical education is the ease of entering the definition of a function at run time The easy (and lazy) way to do this is to enter the definition in a program line There is no delay as the BASIC is interpreted The situation is radically different with Pascal To alter the definition of a function in a Pascal program you must first edit the program, update the disk copy of the text version of the program, then recompile it Apart from this expecting a lot of the user it is time consuming (up to 5 minutes for a medium sized program) Even when this has been done you are limited to studying functions that are defined at each point that is likely to be used as there is no facility for turning off the checking of the validity of arithmetic expressions in APPLE Pascal as there is with PALSOFT BASIC So whether or not you can graph 360 points across the screen for (say) y = 1/x will depend on whether or not one of the points corresponds to x = 0 Clearly unsatisfactory!

There is no obvious way of checking the continuity of a function essential for drawing good graphs Poles can be dealt with by not plotting if values are off the screen, all other possibilities can be dealt with in BASIC by searching the string defining the function for occurrences of SGN and INT and then producing function definitions containing these (see below) — but in Pascal?

The solution (of course!?) is to interpret the function definition in the final program The system we have adopted is to first convert the definition into reversed polish notation once and for all using a program segment that need only be resident in memory for a short time, and then use another segment procedure to evaluate this each time it is required The evaluation procedure, written in Pascal, is of course slower than the BASIC interpreter which is written in assembler language However the higher speed of routine repetitive operations using Pascal means that the same program will run slightly faster when written in Pascal than in BASIC, unless it involves extremely complicated function definitions

In one mode the evaluation procedure adopted sets three Boolean variables to indicate whether the function is, respectively, defined, continuous and differentiable at a single value of the variable and returns its value if it is defined The alternative mode calculates the function s value at up to 360 evenly spaced values of the argument This time three packed arrays of Boolean are set and an array of values calculated

The function defintions actually to be used are BASIC ones Where they differ from the Pascal ones they are slightly more useful to us (e g INT is a standard mathematical function TRUNC is not) Also the BASIC function symbols are all three characters long, which simplifies programming slightly The development of these routines proved surprisingly easy and was an encouraging start to this kind of programming in Pascal (I had earlier written some upper/lower case text editing programs to gain familiarity with the structure of APPLE Pascal, its file handling facilities and graphics)

Once the problem of defining functions was dealt with, routines to draw axes for graphs draw the graphs themselves and to gather the information needed for these (the definition of the function and ranges of x and y values) were quickly written, then combined into a general purpose graph-drawing program Afterwards they were built into graphics based programs to illustrate the definition of continuity the convergence of gradients of chords to that of the tangent and to demonstrate the relationship between a function and its derivative

The graph drawing program also allows the option of storing graphs on disk files and adding a caption which is useful for showing the behaviour of a sequence of functions as the graphs may take some considerable time to draw At present this is done by storing the data needed to draw the graph in a text file which is rather slow I hope later to produce a machine code picture load/same routine that will operate in a Pascal program To produce long-term reinforce

Queen's University

ment of the lesson some hard copy output is desirable for distribution to the students. This is possible as we can produce a disk file (using SCREENBIT to access the screen 69 120 times, so rather slow) that codes the screen image for printing to a Paper Tiger printer at another site. We have also linked the ITT 2020 to an ICL 1904A and thence to a 1906S which gives us access to a graph plotter but we are now digressing from the topic of classroom uses of a microcomputer.

Bearing in mind that potential users of programs need have no familiarity with or interest in microcomputers (and may even feel hostile towards them) good program design is essential. Thus, with BASIC programs that need to input the definition of a function, we shunned the easy approach of asking the user to type in a program line defining the function on the grounds that even learning simple tasks like this could prove off-putting. Instead the function definition is input as a string, then POKED into a dummy function definition that has been padded out with statement separators, taking care to encode keywords correctly. It is now easy to scan the string for occurrences of INT and SGN and extract these to place in other function definitions in order to check continuity of the function.

One area where great programming care is needed is with input from and output to the user, especially the former. All messages output should be in plain language (plain, that is, to the average pure mathematician) and input should be expected in the same form. It is essential to allow the opportunity to correct typing errors (except for single character input, and even there verification should be sought if the outcome would be irretrievable). Thus we don't use READLN to input a number as this does not allow correction of typing errors and, unless input/output checking is off, gives an EXECUTION ERROR #10 as soon as an illegal character is typed. Instead the number is input as a string and decoded in the program. This also allows the input to be echoed to the graphics page instead of the text page, useful with graphics-oriented programs.

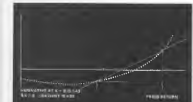
The writing of real numbers in Pascal also leaves something to be desired. Most pure mathematicians are not particularly number oriented and have few routine dealings with floating point notation. The Pascal fixed point format specifies a fixed number of *decimal places* to be output when the normal precision required is to specify the number of *significant figures*. Again the home-produced routine we use to do this can output to the graphics page as well as to the text page. Note also that too much precision, even when it can be justified numerically, can disguise the message. I am convinced that it is much quicker to take in the relative sizes of the sequence of numbers

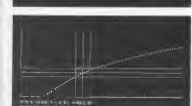
1 20 300 5000
than of the sequence
1 023 21 742, 327 461 5179 782

Programs should be self explanatory once running. Users do not want large instruction sheets to wade through before they can use a program, and programmers working in their spare time will have little desire to document their programs thoroughly. One of the advantages of Pascal over BASIC is that, as long as the program gives adequate explanation at runtime, little documentation is required. It is tempting for an author to assume that he will always be present to explain, for example, the input format needed for a particular program. But even nowadays academics do occasionally move to a different institution and the hope is that programs will be exchanged, so the program has to do it all.

Program exchange is something that must occur if there is not to be a vast duplication of effort in the Universities, Polytechnics, Teacher Training Colleges and, to some extent, the Schools (for there is overlap between 6th form teaching requirements and first year University courses, especially when we consider the needs of those University students who are not mathematical specialists). Such exchange already occurs between mainframe installations at educational establishments, but the greater physical spread of microcomputing facilities makes exchange more difficult for them. These exchanges should certainly be organised on a subject basis, but some other restriction is probably necessary. If it were to be restricted to machines of a single type it would probably prevent schools from exchanging programs with universities. Possibly a regional basis could work (especially in Northern Ireland) but then the problem arises either of translating programs or trying to standardize on a machine type. I am not sure which would be the more difficult, but certainly the problems of translation would be less between different implementations of, say, USCD Pascal than of BASIC.

Whatever the difficulties involved, some solution is essential if the present impetus is not to die under the sheer weight of effort needed to rewrite all the teaching programs desired in each and every educational establishment in the country. ■





- *Dr Wickstead is at the Department of Pure Mathematics, The Queen's University of Belfast, Northern Ireland*

A PILOT PROJECT

Following the series of articles by George Gerhold and Larry Kheriaty in Computer Age Mitac Publishing Ltd have recently released a machine-code interpreter for an extended version of common PILOT for the PET

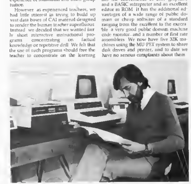
In the first of two articles David Parkinson discusses the experiments in Computer Aided Instruction at Modern Tutorial College that led to the development of this program

Starting Computer Aided Instruction

About a year ago Modern Tutorial College first decided to look at computer applications in education We decided from the start that although we would look at office applications and computing science courses our main interest was in Computer Aided Instruction This was an area which had long been of interest to our principal and one in which he hoped to apply the college s experience of individual and small group tuition

However as experienced teachers, we had little interest in trying to build up vast data bases of CAI material designed to render the human teacher superfluous Instead we decided that we wanted fairly short interactive instructional programs concentrating on factual knowledge or repetitive drill We felt that the use of such programs should free the teacher to concentrate on the learning problems of individual students, particularly in remedial or revision work Obviously if they were to be of any use programs of this type would have to be written by experienced teachers of the subjects in question who could anticipate what problems were likely to be encountered by the student. We therefore needed a computer and a language which could be used by teachers with no previous programming experience

Once we had fixed on the area the choice of computer was fairly straightforward As we had no wish to go out on a solitary limb we wanted a machine already in use in a large number of educational establishments This gave us a fairly straight choice betwen the Research Machines 380Z and the Commodore PET Of the two, the Research Machines is probably more versatile with not much software in ROM but with the Z80 chip and CP M operating system giving a wide choice of high level languages The PET on the other hand is cheap portable, and has the convenience of easy graphics, and a BASIC interpreter and an excellent editor in ROM It has the additional advantages of a wide range of public domain or cheap software of a standard ranging from the excellent to the execrable a very good public domain machine code monitor and a number of first rate assemblers We now have five 32K machines using the MU PET system to share disk drives and printer, and to date we have no serious complaints about them



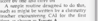
CAI in BASIC

Shortly after buying our first PET a reasonable number of college staff were learning BASIC, and our first CAI programs were being tried out in the classroom These were mainly demonstration programs and simulations for use in maths and science teaching and although they proved quite popular they were not the *interactive* programs we had had in mind We therefore sat down to tackle CAI, and quite soon found ourselves in fairly serious trouble

The fundamental operation in any CAI program is to • input a student response • compare it with some pre determined string of characters and • branch accordingly

For example, in a revision exercise in Chemical Analysis, one might wish to ask a question, input a response and check for the answer ferrous ammonium sulphate If the student got the question wrong one would tell him the correct answer otherwise one would increase his score by one and carry on

A simple routine designed to do this, such as might be written by a chemistry teacher encountering CAI for the first time is shown in **Figure A**



```
100 rem typical cai routine in elementary basic
110 rem
120 input a$
130 if a$="ferrous ammonium sulphate" then 170
140 print"Wrong Answer"
150 print"The answer is ferrous ammonium sulphate"
160 goto 190
170 print "CORRECT"
180 let s=s+1
190 rem start of next question
```

Fig A

Unfortunately there is a great deal wrong with this simple program

1 It is possible to crash out of the program by pressing the RETURN key This is a more serious problem than it may sound as it seems to be a general principle of programs of this type that if they can be crashed using the STOP or RETURN keys then they will be

2 The program is sensitive to capital letters and the responses Ferrous Ammonium Sulphate or FERROUS AMMONIUM SULPHATE will be treated as incorrect One could of course keep the PET poked into the mode in which it can only display upper case characters However, when dealing with reasonably large amounts of text this produces a screen which is difficult and tiring to read

3 The program is equally sensitive to blank spaces and so ferrous ammonium sulphate will also be treated as a wrong answer

4 Finally the equally correct responses ammonium ferrous sulphate iron (II) ammonium sulphate or ammonium iron (II) sulphate will also be treated as wrong.

It is a reasonable prediction, confirmed by our early experiences, that a student is only going to put up with a certain amount of this sort of thing before he accidentally/deliberately crashes the program, plays around with the screen for a while and generally comes to the understandable conclusion that CAI is a complete waste of time.

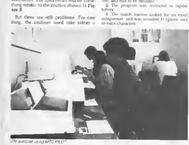
Of course, all these problems can be solved by clever programming. The STOP key can be disabled by a suitable POKE instruction, an uncrashable input routine written by opening a file to the keyboard, or by writing a suitable routine using the GET instruction.

The inputted response can be forced into lower case by taking the ASCII value for each character, and doing a logical AND with 127. Blanks can be checked for and removed – in the routine (B) below, I have done this in a separate loop, for clarity, though it could be merged with the routine for forcing lower case and/or with inputting in a loop using the GET instruction. Alternatives can be checked for using successive IF ... OR ... THEN statements. The final result will be something similar to the routine shown in Figure B.

But there are still problems. For one thing, the routines used take rather a long time, and on PET can cause trouble with garbage collection, in which the computer shuts down all operations for up to about 10 minutes while left-over strings are cleared from the top of its memory.

Next, the input routine is still far from fool proof, and the response 'it must be ferrous ammonium sulphate' will be counted as wrong.

Most importantly of all, it is quite unreasonable to expect a novice to programming to write programs like this. Consequently a number of staff members who started off enthusiastically fairly soon started losing interest in the whole business.


CAI exercise using MTC PILOT

First contact with PILOT

It was in an attempt to solve the last two problems mentioned that we first got interested in the dedicated CAI language PILOT. The first program we obtained was a simulation of simple core PILOT written in BASIC, with PILOT statements stored as data files on tape, then passed to a BASIC program for interpretation. (Commodore have recently released a superior version of the same thing under the name PET PILOT.) In this version of PILOT, the routine already discussed would have been written as shown in **Figure C**.

This is obviously a great improvement in terms of simplicity, and tackles quite neatly the problem of alternative correct answers. However, we soon discovered a lot of problems with this simple solution.

1. The accept routine used could be crashed by pressing RETURN. If the student then typed RUN the entire PILOT program was lost, and had to be reloaded.
2. The program was restricted to capital letters.
3. The match routine looked for an exact comparison and was sensitive to spaces and to extra characters.
4. There was no compute instruction, although counters were provided for purposes like keeping a student's score.
5. Subroutines could not be nested.
6. Editing was very difficult and involved going through the program step by step from the start, re-entering any incorrect instructions.

The obvious first thing to do was to get hold of a better BASIC simulation, and as Commodore's PET PILOT was not then available, we had to write this ourselves. This project was taken on by Mr Michael Bolley from our mathematics department. Before long he had written an improved BASIC simulation with ● input protection, ● a more versatile match instruction, ● a compute command, ● nestable subroutines, ● and a better editor. He also added facilities to ● list programs on a printer, and to ● save and load them from disk.

David Parkinson and Michael Bolley

At this point we ran into three rather fundamental problems.

1. For a decent match, it is necessary to do a window string comparison, searching for the specified string anywhere in the user's response. This is not very difficult in BASIC, but together with the sort of input routine already discussed it slows program execution down to a quite unacceptable extent.
2. A BASIC simulation of PILOT with all the facilities mentioned is a very long program, and even in a 32K PET not much RAM is left available for storing lines of PILOT.
3. When it comes down to it, core PILOT is really not a very powerful language (c.f. the original Dartmouth BASIC).

As these problems seemed insoluble, we decided to abandon the project, and for a while we turned our attentions elsewhere.

Discovering COMMON PILOT

Two events combined to re-awaken our interest in PILOT. The first was the series of articles in *Computer Age* by George Gerhold and Larry Kheriaty of Western Washington University, detailing their extended version of the language, Common PILOT. This struck us as potentially a very much more useful language, containing all the features we wanted and comparable in power to Microsoft rather than Dartmouth BASIC.

The second event was the release by Commodore of a very powerful Assembler development system. It didn't take us long to realise that a lot of things we wanted PILOT to do could be managed by quite straightforward *machine code* routines. For example, it is not too difficult to find the length and start address of a string at the top of memory by searching through the variables table, and to transfer this information to convenient locations in page zero. Having done so, the routine of **Figure D** will force the string into lower case.

Besides being simple, this routine is very fast and will not lead to any problems with garbage collection Originally, Mr Bolley intended simply to add a few routines like this to his improved BASIC simulation of PILOT Before long, however, pressure was put on him to write the whole thing in assembler code so as to produce an interpreter for a version of common PILOT for the PET

The code for this would relocate to the top of memory and would use subroutines from the PET ROMs as much as possible in order to minimise the memory space occupied This would mean that PILOT programs would live in the bottom of memory, just like BASIC programs so that they could be entered, saved and loaded from tape or disk in the usual way, and edited using all the resources of the PET screen editor

```
100 rem same cai routine in advanced basic
110 rem
120 rem disable stop key
130 poke 144 49
140 rem input from file to keyboard
150 open 1 0
160 input#1 a$ print if a$="" then print "" goto 160
170 close1
180 rem routine to force lower case
190 for x=1 to len(a$
200   a$=left$(a$ x-1)+chr$(asc(mid$(a$ x 1))and127)+mid$(a$ x+1)
210 next x
220 rem routine to remove blanks
230 x=1
240 if mid$(a$ x 1)=" " then a$=left$(a$ x-1)+mid$(a$ x+1) goto 240
250 if x len(a$ then x=x+1 goto 240
260 rem routine to check answers
270 if a$="ferrousammoniumsulphate" or a$="ammoniumferroussulphate" then 300
280 if a$="iron(ii)ammoniumsulphate" or a$="ammoniumiron(ii)sulphate then 300
290 print"wrong!" print"The answer is Ferrous Ammonium Sulphate " goto 310
300 print"correct!" sc=sc+1
310 rem start of next question
```

Fig B

```
100 R SAME CAI ROUTINE IN CORE PILOT
110 M
120 M FERROUS AMMONIUM SULPHATE AMMONIUM FERROUS SULPHATE.
130 MM IRON II AMMONIUM SULPHATE AMMONIUM IRON(II) SULPHATE
140 TN WRONG ANSWER
150 TN THE ANSWER IS FERROUS AMMONIUM SULPHATE
160 HY CORRECT!
170 R START OF NEXT QUESTION
```

Fig C

MTC PILOT

This was of course, the start of a very long project for Mr Bolley and in a later article he will discuss some of the problems he encountered writing the assembler for MTC PILOT For the moment, suffice it to say that after a great deal of sweat he was eventually proved successful

As far as possible the syntax of MTC PILOT is the same as that of Common PILOT Thus, for example it has the following features

1 The *accept* command cannot be broken out of by pressing RETURN or the STOP key
2 The *match* is a window string comparison and uses various special characters such as " which will match with any character allowing compensation for simple spelling mistakes
3 There is a *problem* command pr allowing various automatic editing options to be specified including forcing lower case and removing spaces
4 Special *compute* commands allow various special operations on strings such as forcing upper or lower case capitalisation character removal etc
5. There is an *execute indirect* command allowing strings or combinations of strings to be executed as PILOT commands Thus it is possible for example to match successively with different elements of a string array
6 *escape* and *gate* options can be set allowing the user to jump to a label or call a subroutine while normal program execution is halted at an accept statement
7 There are random access *file handling* commands allowing specified blocks to be written to or read off floppy disk These have been designed for maximum compatibility with the MU PET multiple PET system so that several users may use the same PILOT file at the same time

On the other hand, although we have tried to minimise these, the use of the PET ROM subroutines has introduced a number of differences between MTC PILOT and Common PILOT The main ones are as follows

The people of Mitac PILOT

Michael Bolley is a member of the mathematics department at Modern Tutorial College and has been a key figure in the development of computer applications at the college In the course of last year he abandoned an external research degree in order to learn programming MTC PILOT is his first major project undertaken entirely in assembler code

W B Moore is Principal of Modern Tutorial College He has long been interested in innovations in education is responsible for starting the computer project, and has given it continuous active support

David Parkinson is Head of Physics and Computing Science at Modern Tutorial College He was responsible for establishing a computing department at the college, and has been continuously involved in investigating CAL computer applications, and in the PILOT project

1 MTC PILOT can support 2 character variable names
2. It can support string arrays
3 All BASIC arithmetic and string functions can be used in compute statements as well as the special string editing commands from common PILOT
4 The Common PILOT graphics command is not implemented yet Instead there is a special screen command which allows full use of PET graphics in PILOT
5 It is possible to PEEK and POKE anywhere in PET memory as in BASIC

```
LOWERCAS.      PAGE 0001

LINE# LOC CODE LINE

0001  0000                  FORCE LOWER CASE
0002  0000                        *=$0400
0003  0000                  LEN=$5
0004  0000                  STRNG=$5C
0005  0000  A0 00                 LDY #$00
0006  0002  B1 5C           START LDA (STRNG),Y
0007  0004  29 7F                 AND #%01111111
0008  0006  91 5C                 STA (STRNG),Y
0009  0008  C8                    INY
0010  0009  C4 05                 CPY LEN
0011  000B  D0 F5                 BNE START
0012  000D                        END

ERRORS = 0000

SYMBOL TABLE

SYMBOL VALUE
 LEN     0005     STRNG   005C     START    0002

END OF ASSEMBLY
```

Fig. D

```
100 r same cai routine in mtc pilot
110 r
120 pr 144 49
130 ar 1
140 m
150 m ferrous iron(ii)
160 mm ammoniumsulphate
170 tn WRONG
180 tn The answer is Ferrous Ammonium Sulphate
190 ty CORRECT
200 cy #s+1
210 r start of next question
```

Fig E

A sample routine in MTC PILOT which we think avoids all the pitfalls discussed above is shown in **Figure E**

The present position

These, then, are the joys of MTC PILOT, the obvious question remaining is 'is it any use?'

The honest answer is that we do not know First experiments have been quite encouraging, with a history teacher with no previous experience of programming writing a long successful instructional program in only two days last summer Longer term programming projects are now under way We have also put MTC PILOT on the market in a commercial package and have started a registered users scheme so as to share ideas and experience of the language with other users of PETs in education As far as the ultimate worth of the thing is concerned however only the future will tell ■

• MTC PILOT is available in a package consisting of the interpreter a number of sample programs and a manual from Mitac Publishing Ltd Modern Tutorial College Kilburn Lane London W10 4AA for 65 pounds + VAT Enquiries on 01 960 5899

BUSINESS APPLICATION SOFTWARE

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Word-Wrap virtually eliminates the need for carriage returns A word too long to fit at the end of a line is automatically moved to the next line
Dynamic page break display shows the location of the end of a page on the screen Dynamically updates as changes are made
Print enhancements Boldface Double Strike Underline Strikeout subscripts superscripts variable character pitch variable line height and alternate type style or ribbon colour are all possible using a daisy-wheel printer
Flexible formatting the user can choose either a ragged or justified right margin or mix both
Flexible pagination user control of page length top and bottom margins heading/footing/page number locations and pagination directives
Hyphen-Help alerts you when the last word on a line is too long to fit You can choose between hyphenation or moving the whole word to the next line
Decimal Tab allows columns of numbers to be typed as easily as operating an adding machine **WordStar** will line-up the decimals automatically
Paragraph Indent temporarily sets the left margin to a tab stop so that documents with multiple indentations (like outlines) can be typed easily
Program Execution allows a program (such as an operating system utility) to be executed with automatic return to **WordStar**
MailMerge' (optional) is a powerful file merging tool It can combine a file containing names and addresses with a file containing letter text inserting data where variables are specified even in mid-paragraph It enables personalised form letters to be created with a specified salutation and/or closing The same data file can be used for both form letters and mailing labels
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Chained printing' a file name can be specified within text The file will later be printed automatically
'Items are a feature available in the optional Merge Print module at a cost of £65.

MicroPro Products
WordStar is a screen-oriented text editing and word processing program
Software /Manual ' £175/£20
MailMerge (**WordStar** required) is a powerful file merging tool Variables from data files are inserted in specified places within text and rejustified Includes nested and chain printing capabilities
Software'/Manual' £65/£10
DataStar is a system for data entry retrieval and updating
Software'/Manual'', £145/£20

STOCK CONTROL

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Inventory

Comprehensive Stock Control, Sales and Purchase Management System

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2) Quotations based on prices associated with customer type
3) Price lists by customer type
4) Vendor name address and telephone list
5) Sales (customers) and Purchase (vendors) statements
6) Sales and Purchase remittance advice notes
7) Sales and Purchase accounts analysis listed alphabetically by account number On the last page a summary of Purchase or Sales totals for current 30 days 60 days and 90+ days is printed
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Additional features include
9) Ability to customize **INVENTORY** for user s particular VDU and printer
10) Can print invoices order acknowledges copy invoices credit notes and packing lists
11) Generates statements and remittance advices
12) Generates reminder letters first and second
13) Generates orders and order copies
14) Utilities for
a. Percentage uplift of cost related and list prices
b Reset turnover count associated with each product
c Modify existing invoice quotation and purchase order numbers
d Modify client type discount values
15) Stock record maintenance (add modify delete or listed) on all stock record fields
16) Account record maintenance (add modify delete or leave) on all fixed record fields
17) Transaction posting to client account. Facilities cash-in/cash-out and other necessary transaction adjustments Note ORDER and INVOICE produce their own specific transaction records Transaction categories (e.g invoice cash receipt etc) are identified by transaction type
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Animated Revolution

A new British system that [illegible] cartoon making costs dramatically

Stan Hayward, a London computer scientist who has been a leading figure in computer animation for several years, has developed a video animation system that could revolutionise animation.

"The technique of making animated or 'cartoon' films hasn't changed in principle for over seventy years," he said. "Each drawing for a film lasts only one twenty fourth of a second so that it takes literally thousands of drawings for just a few minutes of film."

One of the most expensive stages of production, he explained, was checking animation movements and timing, a procedure known as a "time test". It uses pencil drawings of the animation and, up to now, has been shot on black and white film. It is, in effect, a rehearsal of the movement to be screened.

The problem is, however, that it takes up expensive camera time. On top of that the film has to be processed and the animator may not see the result for several days. Consequently, instead of checking each sequence as it is completed, he or she usually has to wait until the whole scene can be developed and hope that it is correct.

It occurred to Hayward that time could be saved and greater accuracy achieved if an animator was able to shoot directly on to video tape. Changes in the drawing could be made and any variation on movement that an animator might not otherwise attempt could be safely executed. If the same image had been put on film, it could not be erased or altered in any way.

Video-tape had never been used successfully for the purpose before mainly because single frame systems were very expensive and were really modified versions of normal tape machines. Hayward had tried video disks but they were also costly and took up too much storage space when long sequences were shot.

He spent several months considering the problem then hit on the solution. It was to use an ordinary standard Time Lapse recorder of the type employed for security and scientific tests. With the help of Chris Goss, the NRDC prizewinner mentioned in earlier issues of *Computer Age*, he designed a single-frame controller that simply plugged in to the recorder to allow single frames, or any number of single frames, to be taken. He discovered further that the result could be played back at normal camera speed.

The video animation system

The recorder only records in black and film at present, but Hayward said that that was perfectly adequate for time testing. As the recorder will also take sound a sound track can be added and checked at the same time as the movement. Waiting for the film to come back from the processors had been eliminated and the time of the film editor saved.

'The system is so simple,' said Hayward, 'that practically anyone who can draw can animate with it. That applies to educationalists dealing with training films, those working in the animated film industry, of course, and architects and engineers.'

For technical drawings the normal animation board can be replaced by a drafting machine. In addition, the system can be connected to a computer-aided design system to record from display. Graphics can be shot off the screen and replayed frame by frame in real-time.

It was pointed out to Hayward that a similar system was already working in the United States of America. He was aware of it but said that the advantage his system had over the American one was that it was approximately £2,000 cheaper and, further, that it did not need modification for the time-scan operating in British television and in those of several television networks overseas. The American and Japanese television time-scans, in particular, were entirely different.

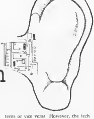
Hayward and Goss were retained for the project by Animation Equipment Engineering at Wembley, near London. Hayward is currently working on a means of adding colour to the system.

A prototype of the system can be seen at the Wembley Headquarters of AEE. It has already aroused considerable interest, especially among teachers of animation who find that animation can be taught and practised more easily with the system. The system costs approximately £4,000. ■

■ *William Collins is a correspondent of the BBC World Service Science Unit.*

David N. Sands

Natural Language Translation



Truth though stranger than fiction is sometimes a word or two behind it

Science fiction "invented" the moon landing; and then reality caught up SF also invented the hand held natural language translator to enable the interplanetary traveller to converse with the natives What progress has been made so far towards that goal? That fictitious artefact has three important qualities miniaturisation, the ability to speak and to hear the ability to translate from one language to another

The trends in miniaturisation are very evident Development in micro-electronics is fuelled by high demand for the products Higher reliability and lower assembly costs result from the lower chip count achieved by cramming more functions into single devices Very large scale integration (VLSI) is also facilitated by miniaturising the circuit patterns on the chip itself The state of the art in track widths is down to around 3 microns and etching techniques using lasers will make less than one micron possible

In the meantime, high-powered processors such as the Z-8000 already make desk top natural language translators a practical proposition, and high power 8-bit processors such as the 6809 or Z-80 make possible highly respectable tasks, especially if they are used in multi-processor configurations The Z-80 for example, rates poorly in benchmark tests run with computer languages such as BASIC, but these languages comprise little more than upgraded 8080 code using only a fraction of the Z-80's 158 instructions The 900-odd variants of these instructions are ideally suited to the bit byte and block operations needed for such tasks as translation or speech synthesis

Speech synthesis is still rather esoteric and has not attracted many applications This is of course, largely because it has not been very good. Anyone who has heard the Texas Instruments Speak n spell will surely have been impressed, and the device is exceptionally good when driven from the Texas TI99 4 microcomputer Such devices, though are limited by a fixed vocabulary What is needed is the ability to compute what the machine has to say This is achieved using a technique called *synthesis by rule* With this technique, hardware is required to synthesise the sounds produced by the vocal tract Parameters output from the computer control pitch and volume vary the overtone frequencies (known as formants) and control the higher frequencies associated with consonants aspiration which produces the H and SH sounds and the nasal sounds in N and M

Massive software is needed to construct the human sounds called phonemes and this is the synthesis by rule *software* Input to the software is usually in the form of phonetic text but systems are appearing which can be driven directly from natural spelling using *look up tables* to establish the correct pronunciation

Sands Whiteley Research and Development have been working for some time with the American Computalker system and have effected major improvements but the system still suffers from some unintelligibility due to poor consonants and a lack of meter or rhythm Tim Orr's system for the M6800 sounds strangely metallic but is sometimes more intelligible due to its real time metering of phrases Both these systems are now being outclassed by exciting new developments in the U S A

Speech input (speech *recognition*) is considerably more difficult

Ideally we want to construct a model of the human ear just as we have a model of the vocal tract for speech synthesis The human ear has a coiled horn lined with nerves (the cochlea) in which different frequencies set up resonances at different positions along the horn Thus the human brain is equipped with a real time spectrum analyser as a peripheral and is able to decipher all the many variations in speech from different human beings

Sands Whiteley Research and Development have one low cost speech analyser which breaks the spectrum into only four ranges With great difficulty the system will recognise up to thirty different words provided that the words are sufficiently different and carefully spoken

In practice, the system is first programmed in learning mode with words spoken by one speaker The software builds up a *table* of words and parameter patterns input from the hardware In recognition mode the pattern of the current word being spoken is compared to the entire table and the word corresponding to the best match is produced If the speaker is changed the system becomes more unreliable and will perform badly comparing a female voice with male patterns or vice versa However, the technique is right and would improve in leaps and bounds given hardware providing parameters from a greater number of more selective filters, and also the ability to repeat the matching with shifted frequency and with varying timescales to allow for differences in speaking pitch and speed Naturally this becomes a full time job for one processor and hence the need for multi-processor configurations

Now to the natural language translation itself So far, Europeans have been happy to accept American technology in English and it could be noted that the British have some advantage here However as technological products filter down through the technocracy, Intelligent machines will have to learn new (natural) languages International diplomacy is one obvious application for translation and in a place such as the European Commission very many documents are produced which require translation from one language to another There are many technical reasons why English cannot become the standard language plus of course the French chauvinistic attitude to the language If we look further to Arabic Chinese or Russian it clearly would be unreasonable to expect English to be used At the document level speech input/output is not necessary, although, in the case of Chinese it might well be the easy option

At this time one can buy hand held translators such as the Nixdorf the Craig Brainbank and now the new Texas device which can actually speak the translation But these devices are little more than phrase-books at present (and probably occupy more space than the written word)

To actually translate a real sentence, such as this one all sorts of problems are encountered For example, the relative positions of adjectives adverbs etc are different from language to language some languages have male/female objects verbs alter according to sense and there are many other problems A true language translation program has to know grammar as well as have a huge stored dictionary of words Translation is further complicated by context, meanings, colloquialisms etc This difficulty was highlighted recently when Hydraulic Ram was translated into French as 'Wet Sheep'

Language

A huge program called SYSTRAN already exists It was written for the IBM370 This program is currently being run on a Siemens computer at the European Commission, and soon terminals are to be installed to enable more people to gain access to the system Inevitably, any mainframe, handling data base and computing functions, being used by more and more people, gets slower and less accessible, and people will require personal machines Sands Whiteley R & D are now working with the Cambridge Language Research Unit and between us we believe we have the ability to put real language translation capability into a desk top machine

We now hear that the Japanese who do not have a reputation for innovation are nevertheless pressing ahead with language translation primarily for their own problem of translating Japanese to English, but ultimately for world markets It we British are to maintain what lead we have and establish a saleable product for the future market we must start work now on both the technology of language translation, and with the hardware and software design of suitable computer equipment capable of handling the task The finished design would allow its operator to prepare a document, using word-processing facilities, and have it printed out in one or more different languages And if the momentum of this project is maintained, then within a decade we will produce the hand held speech input/output language translator ■

Courtesy Cambridge Evening News

David N Sands is a principal of Sands Whiteley a company that is actively researching speech synthesis and analysis He can be contacted at Royston (022020) 689

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Natural Language In Information Systems

This is the second article in an occasional series

In my earlier article (Issue 4) I described some of the reasons why it has been difficult to program computers to respond to "free" natural language. Much the same ground was covered in the last of Mike Fairhurst's articles in the series on AI,* although he dwelt also on techniques used.

Here, and in the next article on Data Base query processing, I want to focus instead on some of the practical applications of the work that has been done in Computational Linguistics and Artificial Intelligence. For much the same reasons as Dr Caplin in Issue 9, I don't see much future in *programming* in natural language but, for casual enquiries of a data base, it can be a sensible approach. In the case of document retrieval, it emerges that rather than create a general-purpose natural language processor as a "front-end" to our information system, it is possible to allow users to phrase queries in natural English (or whatever) using only a limited set of techniques.

Document Retrieval

But first, a few preliminaries about document retrieval systems. I have been careful to use this term to avoid confusion. "Information Systems" often means the whole field of data processing and "Information Retrieval Systems" covers both the type of system to be discussed here and that in the next article. As is usual in explaining the meaning of words and phrases, it is easiest to show what document retrieval means by contrast with something it doesn't mean. The contrast is fact retrieval.

A fact retrieval system might provide answers to questions like

> "How many senior programmers are there in the systems programming group?"

Whereas a document retrieval system would be intended to answer an information need like

> "I'd like to know more about fracture toughness in titanium and its alloys."

A document retrieval system would satisfy a request of this second type with a list of *sources* of information – books, articles, technical reports – which the user can read for himself to obtain the information he requires. Thus such a system provides the services of a good reference library. Such a system will be used when the information stored in the computer is less predictable and limited in format than in the database system implied in the first of the above questions. This is typically the case where the information system is used as an aid to research or learning rather than administration. Of necessity, most of the burden of the structuring and processing of information is not computerized but is left to the authors and readers of the documents.

> *'Our goal is to be able to say what the text is about without saying all that it says.'*

The basic technique of document retrieval (from the software point of view) is indexed file access. Here each record, no matter what its actual contents are, is accessed by a key which has been assigned to it on input. In business information systems it usually suffices to have a single key associated with each record – e.g. a part number or a surname. In such cases, the manufacturer's standard indexed file organization can be used. In document retrieval systems it is usual to have *several* keys for access to each record. We will usually want to be able to access a document record by specifying either its author or the subject. Usually, too, we want to allow a document to be indexed by a number of different subject keys. If this article were held in a document retrieval system, for example, the keys might be COMPUTATIONAL LINGUISTICS, DOCUMENT RETRIEVAL, NATURAL LANGUAGE, INFORMATION SCIENCE. In more specialized journals than this one, it is also common to find articles with more than one author.

The existence of multiple keys simply means that file access must be supported by both multiple directories and multiple entries in the same directory to a document. Such an arrangement is conventionally known as *inverted file access*. One advantage is that just from looking at the index files themselves it is possible to tell a user how many documents there are on his topic – a useful item of feedback in an on-line system which lets him know whether he is casting the net of his query too wide or too narrow. Another advantage of this arrangement is that, by specifying *combinations* of keys, greater precision is allowed for. If, in our hypothetical document collection, there were, say, 100 documents indexed under each of the headings, a query for documents on any one of these subjects would produce too many for our enquirer to read through. There might, however, be only 5 documents on the precise topic of this article and if that is the topic that is wanted the enquiry would have to be phrased

(COMPUTATIONAL LINGUISTICS *OR* NATURAL LANGUAGE) *AND* (DOCUMENT RETRIEVAL *OR* INFORMATION SCIENCE)

You may already have noticed that there was some redundancy ("excess information" – **Editor**) in the keyword sets chosen in both the document description and the enquiry. This is to allow for the use of synonyms and other alternative ways of describing either a document or the subject one is interested in. It is when we look at the principles of describing documents and subjects that the subject of document retrieval becomes more complicated than mere file processing.

Bibliographic retrieval systems are usually assessed for their effectiveness on two measures: *precision* and *recall*. In the example used above, we said that an enquiry for information on the topic of this article could produce many irrelevant documents if we asked for documents on 'computational linguistics'. In the made-up figures quoted, we said there were 100 documents on that subject but only

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*Issue 2

5 of these were on the precise topic of interest. We could say that, for this particular enquiry, the retrieval system achieved 5% precision. If all of the documents in the collection on the topic were included in those five, however, we could say that 100% recall had been achieved. Again in that example it was mentioned that by co-ordinating keywords we could make an enquiry more specific. By such means we could hope to raise the precision or relevance rating, but beyond a certain point we would be so precise as to risk not retrieving some pertinent documents and so undermining recall.

Empirical studies of information systems indicate that normally the best performance that can be achieved is 50% precision, 50% recall. Improvements can be made on one criterion but only at the expense of the other. Even these figures are usually based on enquiries made by trained information workers.

The Linguistic Dimension in Information Retrieval

One of the reasons for the imperfect performance of document retrieval systems is the mental processing of both documents and the information needs of a user.

Figure 1 shows in schematic form some of the transformations that take place outside of the computerized part of the system.

Looking first at the right-hand side of Figure 1, we can start by saying we are not interested here in the process of writing a document (although, of course, a major consideration by the author in doing this is how to structure and phrase his text so that the intended readers will comprehend it).

We start, then, by looking at linguistic aspects of how to classify documents or assign keywords for use in retrieval. Problems fall into two categories:

- how to ensure that the keys used to represent the document are the same as a potential enquirer would use
- how to ensure that the keys represent accurately the contents of the document

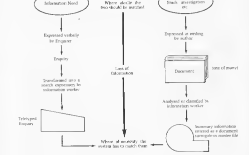
The first problem concerns largely the problem of synonyms: how can we be sure that the same keywords are always used to represent the same concepts? Referring back to the example classification for this article, *document retrieval* and *information science* are, if not synonymous, closely related terms, either of which would do to describe one aspect of this topic. Similarly, *computational linguistics* and *natural language processing* are only distinct phrases to those who are seriously interested in the field.

One solution to this problem is to use a *controlled vocabulary*. This means that, for any given concept or topic, we determine that only one description or keyword will be used in the system. Perhaps the most familiar such arrangement is the hierarchical Dewey Decimal classification. Here the standardization has gone so far as to replace English words by standardized numbers but the principle is the same as if words had been used. What the use of numbers does emphasise is that keywords are not any longer being used *as* English words but their meaning is redefined according to their relationships with other permitted descriptors. Thus exactly parallels the way in which words like *while*, *do*, *if*, *repeat*, *array*, and so on are no longer English words when used in a programming language. The entire controlled vocabulary is thus the lexis of an *indexing language* which, like other formal, artificial languages, is designed to eliminate ambiguity.

The *relationships* of meaning between keywords in the indexing language can be represented in a *Thesaurus*.

A particularly important meaning relationship is that of *hyponymy*, where one term is more general than a number of specific ones. *Cooking* would be a hyponym of *roasting*, *boiling*, *braising*, *baking* and others and *Computer Science* a hyponym of *hardware* and *software*. The relationships between words in an indexing language can be defined by stating for each word what are *broader terms* (hyponyms), *narrower terms* (the opposite) and *related terms*.

The arrangement of a Thesaurus is thus a tree structure. For examples, see


Information Need
Where ideally the two should be matched
Results of Study investigation etc
Expressed verbally by Enquirer
Expressed in writing by author
Enquiry
Loss of Information
Document
(one of many)
Transformed into a search expression by information worker
Analysed or classified by information worker
Teletyped Enquiry
Summary information entered as a document surrogate in master file
Where of necessity the system has to match them

The environment of a computerized document retrieval system

Roget's Thesaurus (of general vocabulary), the *NCC Thesaurus of Computing Terms* and a manual to the Dewey or UDC classifications.

The Thesaurus is of particular use in controlled vocabulary systems as it shows the indexer a context to guide him in the choice of the correct term. It could also be used with an uncontrolled vocabulary to suggest what synonyms or hyponyms could be added to improve the chances of retrieval for a particular document. Again, in both types of system it could also be made available to the enquirer to aid him in his search, but that will be discussed later.

The second problem in indexing was ensuring that the keywords used actually represent the contents of the document. How this problem is tackled depends largely on how and by whom (or what) the indexing is done. It can be done by the author, by a specialist indexer, or in a fully automated system, by computer. The first one is likely to become very common as the number of documents in information retrieval systems increases at a rate faster than that of information scientists on the one hand or the spread of the technology of automatic indexing on the other.

Increasingly, journals are requiring of their contributors that a number of keywords are assigned to articles. In many of the technical journals of computing, a listing of *CR categories* (decimal numbers + key words) are to be found at the heading of each article. This is simply a controlled vocabulary set up for use in the abstracting publication, *Computing Reviews*. For books published in the USA, authors are required to submit this sort of data for the purposes of the Library of Congress. I have an engaging example in an American edition of a 60-word children's story which has the descriptors *rabbits – Fiction* and *pets – Fiction* attached as well as a 10 word abstract. Academic books published in Britain often have similar British Library cataloguing in publication data, but the trend is not ubiquitous in general-interest books yet.

If the author does his own indexing, there is the risk that he will view the contents of his work in an idiosyncratic way, and may overlook topics other than the main focus of his interest which he has nevertheless dealt with. Certainly, having an author index his work in this way is a very economical way of doing this part of the processing of an information retrieval system, as he is unlikely to notice the marginal additional effort.

Where a document collection is maintained by a large organization, it is likely that trained information specialists will be employed to index documents input to the system. As they are also the people who will make enquiries on behalf of end users, this ensures compatibility in the way subjects are described for different documents and in enquiries. The main objection to using specialist staff in this way is, of course, the cost, and so research proceeds on automatic indexing and abstracting.

Natural Languages

Automatic techniques for indexing documents and producing abstracts of them are already in use to a very limited extent.

There are two main ways of going about the problem, one statistical and the other linguistic. Statistical methods are based on word frequency and co-occurence. One of the objections to such methods from a linguistic point of view is that the counting of 'surface' words is not an accurate indication of the relative importance of a concept in a text because of the possibility of the use of synonyms. However, there are probably less synonyms available for many technical terms than for words of wider usage, so frequency and co-occurrence work quite well. We do not concentrate on the *most* frequent words in a text because there often turn out to be what linguists term *function words* – articles, prepositions, conjunctions and so on – rather than *content words*. All sorts of justifications, linguistic and pragmatic, can be used to determine just what range of frequency is most relevant.

> 'The essential problem in matching a user's information need and the documents in a collection is that he doesn't know what he needs to know.'

By relatively simple methods it is possible to go beyond mere listing of concepts from a document to deriving a representation of the relationships of those concepts. We do not have the fine grain of semantic relationships, but measures of association based on the proximity of words in the text to one another can give a rough indication of the conceptual structure of the information in a document. In such an analysis, we would consider two words which frequently cooccurred within the same sentence as being more closely related than those which were only in adjacent paragraphs. We'll come back to such structured representations later in relation to the representation of the user's query.

The other type of method for document analysis is to look for actual syntactic and semantic relationships, not the mere probability of them. Like much work in computational linguistics and artificial intelligence, text linguistics holds out prospects for the future rather than the present. How would we approach the problem? What linguistic aspects of a text are relevant to its retrieval in a mechanized system, and to the creation of an abstract that will allow an enquirer to assess its interest to him without reading in full?

Our goal is to be able to say what the text is about without saying all that it says. This will not be the same as saying just a reduced version of the original text. If we set about it without some conception of the structural properties of texts (as many school children do in précis writing) we would get nowhere. At a very general level, all texts, whether fiction or not, have something equivalent to a *plot*. This is indisputable, but the problem is, can we get at such a representation without processing the whole text? To do a good job, probably not, but heuristic methods might lead us to make a lot of the introductory and concluding sentences and the structure of paragraphs used by the author in between.

Another linguistic property of texts is that they have a *topic* and *comment* structure. If we could identify the linguistic structures used to introduce new topics into the text we would probably get a good idea which of the concepts dealt with are the ones which distinguish the particular author's contribution to the subject and thus express what the document is about.

To do the job as people do, however, would need the full range of AI treatment including knowledge representation of the subject matter with which to compare each document. For the time being, need I say more?

Query processing

Let's now turn to the left hand side of Figure 1, where we look at how the information needed by an IR system user is expressed. Several difficulties present themselves. Let's start with the smallest of these.

Firstly there is the problem of the *morphology* of words. That is, the way their endings change as they are used in different syntactic roles. In most cases it is the core of meaning that is represented by the root form of the word that is important for IR purposes, so we can apply techniques based on the morphological rules of English to eliminate suffixes and use the root as the criterion for a match between words of the query and those describing documents. A system known as MORPHS in use at the Malaysian Rubber Producers' Association uses techniques like this. Alternatives would be to use partial matching criteria not informed by linguistic rules, or listing of morphological variants in a synonym dictionary.

A bigger problem is that of synonyms and paraphrases. The essence of the problem has been discussed in relation to the analysis of documents. Solutions will again depend on whether expert intermediaries are to be used or whether end-users have direct access to the system. The system I was involved with as a research assistant used the Universal Decimal Classification (a more complex version of Dewey) and we used a combination of strategies to get around the paraphrase problem. The essence of the approach was to allow the user to scan up and down the UDC schedule tree (the Thesaurus in this indexing language) This could have been implemented totally by menu-selection starting at 0 Generalities 1 Philosophy but to cut down the length of the dialogue we entered the schedules at a much lower point by analysing a query made in unrestricted English

Let's take a look at how the system treated an example query (system in upper case)

```
PLEASE TYPE A SHORT DESCRIPTION OF
YOUR AREA OF INTEREST
electroless plating with copper
I DON'T UNDERSTAND THE WORD
ELECTROLESS
PLEASE ASSESS THE FOLLOWING
1 COPPER AND ITS ALLOYS APPLIED AS
A COATING
* * *
too general
PLEASE ASSESS THE FOLLOWING
```

The trouble about "electroless" was that whilst this word did appear in a query by a metallurgist, and was obviously in use it was in fact a neologism for which the correct form should have been 'non-electrolytic' The system ignored it and processed *plating with copper* to index the point in the schedules which was presented to the user

How did it come to select just the line

Natural Languages

above? When there is a large number of UDC classes featuring *Copper* and quite a few featuring *plating*? Simply by ignoring all the UDC classes which did not feature *both* of these terms in their English descriptions Combining this with another heuristic designed to err on the side of generality we found that in order to facilitate matching by UDC class numbers no more complicated linguistic processing was needed We could allow the user to express his information need in unrestricted English and have the computer convert this into the restricted form necessary for a match against the document collection If the system's interpretation is not exactly as intended it uses the structure of the UDC Thesaurus to allow interactive modification of the query and also to elaborate it to build up boolean term combinations which non-programmers find difficulty with when unaided

There are, of course, many other experimental 'user friendly' information retrieval systems and in fact using the UDC as we did would be regarded by many as idiosyncratic

One interesting research system is being developed by information scientists at the City University and Aston University under the name of ASK – an acronym for *anomalous state of knowledge* The essential problem in matching a user's information need and the documents in a collection is that he *doesn't know what he needs to know* His information need arises from the fact that he has detected a gap of some kind of his knowledge of a field and he wants information to fill it The problem then is expressing what he needs to know without knowing exactly what it is It is to get around this problem that the designers of the ASK system are using structured representations of an extended free natural language query to detect gaps in the subject's knowledge of the area which can be filled by one or more documents from a collection Methods used are based on measures of association, as described earlier in the section on indexing and abstracting

In conclusion, because it is never possible to predict how the information will be structured in a given document overcomplicated syntactic and semantic analyses of queries will be of little avail in enhancing system performance Analysis of *documents* by such methods may however be of use in the future

Fortunately the problems are nowhere near so intractable in relation to *fact retrieval* from structured databases and when we look at that in the next article there are several interesting systems running natural language dialogues with users ■

● *Bill Black is a lecturer at the Department of Computer Science Teesside Polytechnic Middlesbrough Cleveland*

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THE TRUTH ABOUT BENCHMARKING

Part II

In this second and concluding article Alan Gay who is the Manager of a University Computer department discusses benchmarking for systems used interactively

In a previous article I discussed some of the difficulties which are encountered when trying to define, set up, run and interpret the results of a benchmark. In that article I concentrated on batch runs which did not involve any human interaction. This article discusses some of the extra problems that are encountered in trying to set up a benchmark for a computer system that is heavily dependent on the actions of interactive users.

We must first define what we are looking for in our interactive system. As with a purely batch system we will require a certain minimum throughput rate to enable the workload to be processed adequately. But, in addition, we need to give to the interactive users an 'acceptable' response time.

Broadly speaking, we may define response time as the time between a user at a terminal giving input data or instructions to the computer and the computer giving him his results or being ready to receive the next input from him.

Obviously, one of the major factors affecting this response will be how much work the computer has to do before being read for the next interaction. To some extent what is an "acceptable" response time to the user will depend on his conception of how much work the computer has to do. Thus a user who is using his interactive terminal like a typewriter, and continuously entering lines of text to be stored in a file, will expect the computer to be able to accept the data as fast as he can type it in. A user who is entering data to an interactive program which does a lot of processing and then produces results will expect a noticeable delay before these results are output to his terminal. Nevertheless, his rate of working, and thus the throughput of the computer as he sees it, will be determined by these delays.

When we try to define our interactive workload we may, very broadly, consider two types of interactive work. The first type may be described generally as **file manipulation**. Under this heading we may include ● setting up and editing files, ● cataloguing them and inserting them in libraries, ● putting them on queues for spooling or job entry, etc.

The second type consists of ● interaction with user-defined programs which accept data, perform some processing and produce results.

There is a very important practical difference between these two categories. Tasks in the second category will, with minor differences, expect similar input and produce similar output when converted from one computer system to another. Tasks in the first category are very dependent on the terminal control language and facilities offered by the system under which they are running. They are also very dependent on the whims of the user running them. He may drastically change his way of working to match the facilities available or to avoid actions which cause long delays in response.

As with a batch benchmark it is usually far better to set up a synthetic benchmark, rather than a random cross section of a day's workload. Thus we might set up a mix of terminal sessions with a certain number developing programs of various lengths and others running interactive programs with varying demands on system resources.

An unknown system

If we are setting up a test for an enhanced version of an existing system we will know the ways in which the users work and can describe a terminal session in terms of the actual system commands to be given. But if the test is for an unknown system, or for a variety of different systems, although we may be able to define the production programs and their interactions fairly closely, we can only define the system-dependent part of the workload in general terms, e.g. the user logs on to the system, adds 100 lines to a previously stored Fortran program of 2000 lines, lists it, changes 10 lines, compiles it ... rather than defining the exact function of the commands given at each stage.

Although such a procedure makes possible the conversion of the test to different manufacturers' systems it increases the difficulty of *comparing* the results, and gives rise to considerable difficulty in ensuring that the conversion is 'fair'. A simple sequence of actions such as that described can, on some interactive systems, be handled by a subset of the terminal system which imposes less computer overheads than the full system and thus gives better throughput and terminal response. But these subsystems often have limitations in their facilities that make them unsuitable for the general user.

The measurement of response-time poses further problems. The responses to be measured are small, and often the number of terminals is very large. The number of interactions may be measured in hundreds every second. To produce information on the timings of these, and to collect all the information in a file ready for future analysis would impose a very heavy load on the system under test, and would cause a great distortion in the responses being measured. Clearly this violates a basic principle of scientific investigation that the observer must not influence the subject of the experiment.

Of course, it is not only the collection of information that can affect the results of the benchmark. The human beings taking part in the test as interactive users will also have a major influence on the results obtained. Although they will be restricted to following a standard script of computer instructions, the way in which they do this will vary markedly from person to person and from test to test. In general, as they become more used to what they are doing, they will type faster and pause less often. They will continue to make mistakes, at random places and causing varying amounts of extra computer activity. Sometimes these mistakes will be so severe that the user is unable to carry on with his part of the test.

The emulator

It is therefore necessary to do away with the human element in the benchmark. This is done by replacing the interactive terminals and their human users by *another computer*, which is connected to the computer under test by communication lines and simulates the activity of real users of those lines. This 'terminal emulator' will hold as data a set of previously prepared interactive scripts, and will present these to the target computer according to a set of rules that can be adjusted to match the characteristics of real users.

Two of the most important of these characteristics are typing speed and 'think time', that is, the pause before starting to type in a line of input. It is usual to randomize this think time within certain defined boundaries having a uniform think time can result in all the scripts getting into step and not causing the peaks of activity which would occur in real life For this reason also it is best to stagger the starting times of the various scripts

Driving the benchmark from an external emulator also solves the problem of obtaining and storing measurements of response times without affecting the system being tested All this can be done in the emulator which sees the target system exactly as a terminal user would and appears to the target system just as a set of terminal users However, as I said earlier the acceptance (or otherwise) of response delays is influenced very much by the user's view of how much the system is doing for him at any time This view is something that the emulating system cannot have without a detailed analysis of the various commands that it is passing to the target system Such an analysis can be done during the run if the emulator is sufficiently powerful, but it is better to collect all the available response time information so that various analyses can be performed on it later

The emulating system is naturally very dependent on the workings of the target system Any unexpected output or request for information, which would cause no problem for a human being, can be an insurmountable difficulty for an emulator programmed to work in one particular way The analysis of the results is also dependent on a detailed knowledge of the meaning of the system commands As a result of this terminal emulators tend to be fairly large computers in their own right, and to be produced, by a computer manufacturer to work only on one particular system

Thus when an interactive benchmark is produced, there is often far more need than with a simple batch benchmark to adapt it to fit in with the emulation system available for each particular machine to be tested The whims of the writers of the emulation system will also dictated

Benchmarks

the type of analysis that is done on the results and the amount of detail given It will therefore be far harder to make any comparisons between the various computers being tested

Most computers manufacturers now have available benchmarking systems which are more or less useful, and testing centres where the computers are available and a configuration can be set up to match that intended for a particular customer Of course, using a large external emulator to drive the benchmark precludes it being repeated at the customer's site after he has actually bought his computer, so it is generally difficult to use the performance of the benchmark as part of the contractual terms for the acceptability of the installed system However, it would be even more difficult to draw up a contract which involved the behaviour of a large number of live terminal users

What sort of results are we looking for, if we can get them? We must try to find some figure or set of figures that gives us a sensible impression of how the system appears to a user at his terminal, and also how it changes as the load fluctuates

If the load we are measuring imposes little strain on the computer, such as users simply typing in data to a file line-by-line, then the response time should be fairly constant until the work reaches a level where some critical software or hardware limit is reached Such a limit might be the throughput rate of a communications front-end processor or the amount of processor power needed to translate or re-format the lines When this point is reached the response time will increase very rapidly

If the load affects just the processor, i e if the load consists of a set of programs which do a lot of computing between interactions, and do not involve much use of other system resources such as disc transfers then the response – that is the time between interactions – will be directly proportional to the load It can then be calculated for varying loads from just one set of measurements

Overheads

But the most interesting case, and the one that will give us the most trouble comes when the load uses a variety of system resources Many of these resources will have overheads associated with their control and management and these may become the dominant factor as usage increases This leads to a classic exponential degradation in response time, which generally looks something like one of the various curves in the diagram

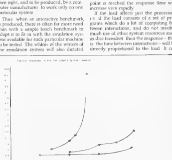
Of course, different types of interaction will exhibit different behaviour, and the response to the same interaction will fluctuate according to the level of activity on the system at any given moment. It is therefore best to gather average response times over a range of similar actions, e g all file manipulation commands The range should not be made too large – to include the response to fairly large program runs would produce an average figure which would not represent any type of real work

In order to get some idea of the shape of this curve for any particular system, it will be necessary to run the test several times with different loads i e different numbers of simulated terminal users It is obviously vital that your eventual use of the system leaves you well to the *left* of the area of the curve where the response starts to degrade rapidly

Many computer systems, when reaching the limit of their capacity, show other alarming symptoms to the terminal users The response time will become increasingly erratic which is generally more annoying than a constant poor response For this reason it is important to demand other results from the benchmark *in addition* to the bald average response times Useful figures include the maxima for various types of response the mean deviation and the percentiles of responses in certain time intervals

However, experience shows that however desirable it might be to obtain all this information when assessing computer systems most manufacturers' terminal emulation systems will provide only a small subset, and in each case a different subset It is therefore only possible to use the results to make comparisons between the computers if the expected workload is fairly simple and well defined, and then only in a relatively superficial manner It is a great mistake to expect any benchmark and especially one that does not involve a great deal of time effort, and expense to be the sole or main deciding factor in a computer evaluation exercise If you are involved in such a project, I hope that I have pointed out some of the difficulties you will face and given you some ammunition to use against non technical management whose attitude all too often is "run a test and see which is fastest"

■



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COMPUTERS ARE FOR PEOPLE

This is a full chapter from Martin Banks's highly acclaimed primer Living With the Micro which is published by Sigma 5 Alton Road Wilmslow Cheshire SK9 5DY

It is natural to wonder how software is created for it is a creative process.

Very few people are, or ever will be involved in designing the systems software which is concerned with the housekeeping duties of a computer. Similarly very few will actually write the system programs such as assemblers, interpreters or compilers. These will continue to be supplied by computer vendors or specialist suppliers in some form of computer readable memory – be that cassette disk or ROM.

The area that will affect many users is the writing of applications programs. This is evident from the current tide of home computers' including the established names of PET Apple and Tandy but also companies that are usually associated with entertainment in the shape of TV games. Prominent amongst these is Atari, who launched their home computers during 1980 against their strong computer games background.

Some users of such systems may never even write their own programs they will use the vendor supplied programs. Later, they may be able to select programs from Teletext and Viewdata services in which the programs are beamed to the user through the air or along the telephone wires. A vast library will exist of programs in the popular areas such as games, business and education.

But what of the individual? Market forces will dictate that only those programs that appeal to 80 per cent of the target population will ever see the light of day.

With the advent of low priced programmable home-computers, creative individuals will not be left out. They will be able to use a computer to draw pictures (in colour) print messages and perform complex calculations all in fractions of a second. For them the computer will be an extension of their intellect. Naturally, such people will make contact, form groups and exchange programs. An underground movement of new intellectuals will begin.

So how will you enter this new area? You will need to learn how to program proficiently, many courses are available. What can be done is to show some of the rudiments of programming, so that you can decide if you wish to take it further. There are various levels of programming. The lowest and most difficult level is machine code programming in which the program consists of a list of consecutive binary instructions. To make life slightly easier, these can be simplified into numeric codes relating to the octal (base 8) or hexadecimal (base 16) systems. As humans are used to counting in the decimal (base 10) system, this is initially confusing. At the next level of programming 'assembler languages' provide mnemonics for the numeric codes such as IN (input some data) OUT (output some data) ADD (add two numbers together) and JMP (jump to a different part of the program). But, such mnemonics are quite unrelated to our normal usage of the English language or of mathematics. Also an assembler language requires the user to be familiar with the internal structure of a particular computer.

There are as many assembler languages as there are computers, thus limiting their general usefulness. The main use of assemblers is to write time critical routines such as those responsible for taking data to or from external devices.

Basic

Higher level languages such as BASIC (the *lingua franca* of the small computer world) have many advantages. They are

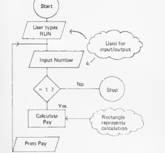
- easy to learn,
- very similar to English and/or mathematics,
- more efficient than low level languages.

The last part is very important, typically a line of BASIC is translated by the compiler or interpreter program into seven to ten machine level instructions. It has been estimated that the average programmer can only write 1000 lines of *correct* programming in one year be that in machine code assembler or BASIC. This means that by using BASIC an increase of efficiency of at least 700 per cent is possible over machine code this partly explains why there are so many job va cancies for BASIC programmers, so few for assembler programmers

Let us begin our excursion into programming with BASIC, the easiest of all programming languages A BASIC program consists of a sequence of numbered *statements* The statements are generally obeyed in a numerical sequence from lowest to highest BASIC is usually implemented by an interpreter program The user can type a BASIC statement and the interpreter will examine it to see that it is in a valid form This implies that BASIC has a grammar or *syntax* just like a natural, human language For example the statement

10 PRINT "HELLO"

is syntactically (grammatically) correct



When executed, it will cause the computer to print HELLO on its screen or typewriter But the statement

"HELLO" 10 PRINT

would not be accepted because BASIC requires that the line number comes before the rest of the statement A complete BASIC program is easily written and its meaning is fairly clear even if you have not encountered the language before

```
10 PRINT  HELLO WHAT IS YOUR NAME
20 REM    THE USER TYPES ANY NAME. THIS IS
30 REM -  REPRESENTED BY THE SYMBOL A$ BECAUSE
40 REM    WE DO NOT KNOW WHAT WILL BE TYPED
50 INPUT A$
60 PRINT "WHAT ARE YOU DOING TONIGHT" A$ "?"
70 END
```

To make this program operate, the user will need to type RUN, the result will be, for a user called Anna the sequence

HELLO, WHAT IS YOUR NAME?
ANNA
WHAT ARE YOU DOING TONIGHT ANNA?

WHAT ARE YOU DOING TONIGHT ANNA?

Notice that the word INPUT causes ? to be typed, prompting the user to type something As you can see computers are only human! Also you can see that most of this program is self-explanatory (a useful feature of BASIC) but note that.

- each line is numbered Any ascending sequence can be used but by leaving gaps (10, 20, 30) we can easily insert extra lines whereas we could not if the line numbers were consecutive
- Messages are enclosed in quotes " " and normally initiate a new line But if ; appears after a message we stay on the same line as in statements 10 and 60
- Helpful comments can be included in REM (short for remark) statements
- 4 Input text (e g ANNA) is assigned to a symbol containing a letter followed by a sign $ sign In our example, we used A $

There are some differences in BASIC dialects on different computers relatively minor but sometimes sufficient to cause problems You must read the manual carefully!

Calculations are handled easily in BASIC by writing formulae in just the same way that the buttons are pushed on a calculator Here is a small program to calculate the take home pay of an employee You will notice that unknown quantities are represented by letters such as P H, D just as they are in simple algebra

```
100 PRINT  BASIC PAY THIS WEEK
110 INPUT P
120 REM    VALUES ARE REPRESENTED BY A SINGLE
120 REM    LETTER OR A LETTER FOLLOWED BY A DIGIT
140 PRINT  HOURS OF OVERTIME
150 INPUT H
160 PRINT  TAX ALLOWABLE DEDUCTIONS
170 INPUT D
180 REM    CALCULATE GROSS PAY G  OVERTIME RATE
190 REM    IS £2 PER HOUR
200 LET G = P + H * 2
210 REM    SUBTRACT DEDUCTIONS AND CALCULATE TAX
           (T)
220 LET G1 = G - D
230 REM    G1 IS THE PAY TAXABLE AT 30%
240 LET T = .3 * G1
250 REM    CALCULATE NET PAY N
260 LET N = G - T
270 PRINT "YOUR NET PAY IS" N
280 END
```

Notice that * is used for multiplication to avoid confusion with the letter X (Many computers still only display capital letters)

After the user has typed RUN the following dialogue would be possible

BASIC PAY THIS WEEK? 100
HOURS OF OVERTIME? 10
TAX ALLOWABLE DEDUCTIONS? 30
YOUR NET PAY IS 128

This could form the basis of a useful program but it has several deficiencies including fixed rates of tax and overtime oversimplified allowance calculations (how much is paid in health insurance union dues and so on?) and the fact that we must re-RUN the program for each employee For simplicity let us ignore all but the latter problem how can we make the program process more than one employee s data? To answer this let us approach the problem in a more systematic way We need a design method that will enable us to produce programs at a higher intellectual level than BASIC coding which is as you have seen easy One aid to good design is the flow chart which uses standard symbols to represent various functions For example we could re-design our program so that firstly, the program asked the user to input a number 1 to process the employee s pay 0 to stop This implies that a decision must be made within the program after testing for the value of this number Testing is represented by a diamond symbol in a flow chart

In BASIC, the decision is achieved with the aid of an IF statement The word IF is followed by the condition to be tested the word THEN and the statement number to go to if the condition is fulfilled Not unnaturally this is called a *conditional go-to* Also available are the words GO TO which cause the program to jump unconditionally to a specified line number To mimic the flowchart, each of these is required

```
- - →10 PRINT "TYPE CODE
     20 INPUT C
     30 IF C = 1 THEN 100
     40 REM   NEXT STATEMENT IS REACHED IF C DOES
              NOT = 1
- - -50 GO TO 320
              ↑
       Lines 100 to 200 as before
              ↓
     300 REM  NOW GO BACK TO THE BEGINNING
   - 310 GO TO 10
- - →320 END
```

The cyclic return path is called a loop BASIC also enables loops to be set up automatically using the FOR NEXT pair of statements For example if we knew how many employees there should be in then this number (say N) can be used to control a loop

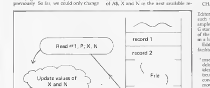
```
┌- →10 FOR I = 1 to N
¦    20 PRINT "EMPLOYEE NUMBER
¦          ↑                ↑
¦       main program as before
¦          ↓                ↓
└-  300 NEXT I
    310 END
```

Automatically the program will loop around N times, printing the employee's number and pay

The fact that several parameters were fixed (e g overtime rate) was mentioned previously So far, we could only change thus by having extra INPUT statements or by changing every statement in which they occur A more flexible approach is to store each of these quantities in a DATA statement which has an accompanying READ The READ statement sucks in the values usually at the start of the program For example

```
 5 READ A, B  C
15 DATA 2, -8  19 3
```

causes A to be set equal to 2, B to -8 and C to 19 3 If A B and C were to have different values only line 15 would need to be changed, not each line in which A, B or C occur Thus the data statement is a form of semi permanent storage more permanent than INPUT but less so than the very important *file* storage



In BASIC a file is an ideal means of storing data that needs to be accessed from time to time, and possibly updated. For example, a file would be useful to store the name of an employee his number pay and tax to date BASIC allows files to be specified and there are special, sometimes complicated, ways of using them within a program Files are divided into *records* much as a book is divided into chapters Within reason, any information can be stored in a record For example we could store an employee's name previously input to A$, his number, X and his computed net pay N by writing

```
50 WRITE #1, A$, X  N
```

Again there are problems of dialect, some BASIC's use PRINT instead The hash mark # tells us (and the interpreter/compiler) that a file is to be used This statement would store the current values of A$, X and N in the next available record If a particular record is needed, we may write

```
200 READ #1, P  A$, X, N
```

This would read the contents of record number P which could be updated and then written back to the file if we desired (See figure) This is a direct access (or random access) file that permits reading and writing at any position in a more or less fixed time Another type sequential access only allows records to be read, or written to in strict sequential order Files are of great importance in many business applications They are used as a primary source of management information and considerable effort is expended in their efficient and compact storage If files are to be accessed infrequently they may be stored on cassette tape Floppy and hard disks provide greater storage capacity and faster access but disk hardware is much more expensive Cassette tape files can only be processed sequentially but they provide a very low cost medium

Editing

Files of data are also important as a means of storing *programs* for both long and short periods If a program is stored in the file, it can be altered or corrected with the aid of a special program called an 'editor' A good editor allows the user to make changes *very easily* to his program For example a 100 line program may have been typed with the word PUT in several places where LET ought to appear Without a decent editor the user would have to eyeball the 100 lines for each such error correcting each one if and when he finds it With a proper editor he simply types a command which causes the automatic replacement of each PUT For instance

```
CHANGE/PUT/LET/G100
```

Editor commands are usually specific to each type of computer The above example refers to one particular editor The G stands for Global replacement – in each of the 100 lines possibly more than once in a line

Editor programs can have many other facilities, including

- insertion of new lines
- deletion of unwanted lines
- identification of lines containing particular keywords
- concatenation of two or more files
- movement of lines from one place to another
- renumbering of lines (e g a BASIC program)

For security, the correct file and the original one are each stored separately so that if one file is accidentally erased there is a back up copy The edited file can be processed by the interpreter or compiler in just the same way as the original was input via the keyboard Editors are always supplied with larger computers but they rarely come as 'standard' on an inexpensive small computer Usually, editor programs can be purchased for the more popular micros

BASIC is not the only language nor is it the best It is simply the most widely available and the easiest to learn One drawback to the language is its lack of 'structure' This means that it is not easy to tell simply by examining a BASIC program what it is supposed to do This might not be thought of as a major fault but it does have the effect of leading to careless design Programmers often begin at the beginning and stop at the end without systematically analysing the problem that the program will eventually solve

In the last decade or so, programming techniques have evolved that enable the programmer to break down the problem into smaller and smaller steps until, eventually he reaches the level of detailed coding This is called a 'top down' approach and the generic technique is referred to as structured programming The logical content of the structured approach is retained in more modern programming languages They look very much like natural language which was, after all, the language in which the original problem was posed! The most popular of these newer languages is *Pascal* named after the French mathematician Blaise Pascal It is a language rich in meaning as shown from the following version of our take-home pay program

```
CONST
        TAXRATE = 30
        OVERTIME = 2
VAR
        BASICPAY DEDUCTIONS, GROSSPAY  REAL,
        TAX NETPAY  REAL,
        OVERTIMEHOURS  INTEGER;
READ (BASICPAY OVERTIME, DEDUCTIONS)
GROSSPAY = BASICPAY + OVERTIME * OVERTIME
HOURS,
TAX = TAXRATE (GROSSPAY  DEDUCTIONS
NETPAY  GROSSPAY  TAX
WRITE (TAX, GROSSPAY NETPAY)
```

Several points are noteworthy

(1) at the start of the program, the user has to describe the constants (CONST) and variables (VAR) He must say which of the latter are integers (INT) and which are decimal (REAL) The list of constants is similar to the DATA statement in BASIC,

(2) meaningful names can be used unlike BASIC which only permits names such as X or G1,

(3) the symbol = (pronounced 'becomes') is equivalent to the BASIC use of LET

Pascal goes far beyond the manipulation of numbers and letters The programmer can define his own data particular to his program For example, he can write

DAY (MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY SATURDAY, SUNDAY)

and later in the program, he can input the day of the week

READ (DAY)
WRITE ('TODAY IS DAY)

Also, the selection of alternative actions is neatly accomplished by the use of the IF THEN ELSE statement For example we could follow the READ (DAY) by writing

IF DAY = MONDAY THEN WRITE ('THE START OF ANOTHER WEEK') ELSE WRITE ('JUST ANOTHER DAY')

As a numerical example, we could calculate the bus fare to be paid by a passenger of any age

```
IF (AGE >65 OR AGE <5) THEN FARE = 0
 ELSE
   IF AGE < 14 THEN FARE = MILES 5
     ELSE FARE = MILES 10
```

This presumes that we have already declared AGE, FARE and MILES

Finally, just as in BASIC automatic loops can be used In Pascal, they are more elegant since the programmer can specify that a loop is to continue while some condition is fulfilled For example, the following short program will read a sequence of numbers while their running total is less than 100

```
READ (FIRST NUMBER)
SUM = FIRST NUMBER
WHILE SUM < 100
  DO
    BEGIN
      READ (NEW NUMBER)
        SUM = SUM + NEW NUMBER,
    END
```

Pascal is seen to be an elegant language, but because of its richness is not as simple as BASIC for the beginner Nevertheless most experts believe that it will rival BASIC in the microcomputer area, within the next few years

Conclusion

Whichever language is used you can be sure that the program is never right first time Be prepared to start all over again because, in this area in particular everything takes twice as long as you think! ■

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HIGH LEVEL LOWER CASE

The author discusses the 'lower case' programme in FORTH and gives a statistical programme used in training at the Polytechnic of the South Bank

I'll start this month with a listing for the lower-case programme in *high level* FORTH and you see the similarity with the assembler listing of last month. The FORTH assembler has very much the idiom of FORTH itself. The word KB, which is defined on screen #83, returns the ASC value of any key hit until 'ESC' is hit, when you break out of the loop. The word ——> which appears at the foot of this screen causes the next screen to be loaded automatically, i.e. it chains the screens. For the benefit of newcomers I would point out that the programme appears on the final screen #85 and consists of the word CASES in a colon definition (a colon is always used to *define* a word). Every word which follows CASES is a word *previously* defined in this application, i.e. on Screens #83 and #84, has been previously added to the dictionary of general-purpose words by *myself* or else was supplied with the *original* language. The whole programme is easier to write than the assembler version and since speed of operation is of no interest, last month's version was given merely as an illustration of the assembler. The CASES programme leaves much to be desired but improvements will have to wait until I've more time.

At the Polytechnic of the South Bank we run a foundation semester in applied sciences, which is attended by prospective physicists, industrial biologists, polymer chemists, food scientists and applied scientists generally. As its name implies it is a preliminary course prior to embarking on the more specialist studies. We introduce micro computers as an everyday tool in the laboratory with the aim of showing their usefulness and of taking away the aura of mystery which surrounds them. I show here an elementary statistical programme we have used. The fundamental programme is on screens #89 to #93. This last screen contains no compilable material and is simply *displayed*. This enables me to write instructions in the format in which they will actually appear to the students. A word is defined to display the screen thus,

STATISTICS-GEN 93 L ,

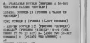
STATISTICS–GEN displays this screen. As a variation, screen #92 compiles and consists of the single word DOPE which, when involved, prints out the instructions which appear there. For the sake of interest I show what these look like when actually printed.

In use, the students measure the values of 100 electrical resistors of the same nominal value. They use a digital multimeter for this. They then enter the values of these at the keyboard of an Apple II. The words 'HISTOGRAM' and 'RESULTS' are self-explanatory and an example is given of actual results obtained. These lead to some speculation. The sample probably contained resistors from two separate production batches. A larger sample might have shown two clear groupings. There is no attempt made at this stage to teach programming or computer hardware. They know what the computer does but not how it does it. They don't know either, in any sort of detail, how the multimeter works. Familiarity, we believe, should precede understanding. They do know, of course, how the statistical measures are defined and, we hope, what they signify. The next step will be to *interface* the measuring device to the computer to remove the tedium of keyboard entry. The advantage of FORTH for these programmes is that it is easy to write and to modify as snags arise. The impact of single words makes them easy to use.

```
( #83 LOWER CASE

141 CONSTANT RETURN
-16384 CONSTANT (KEYBOARD)
-16368 CONSTANT STROBE
155 CONSTANT ESCAPE
: KEYBOARD (KEYBOARD) C@ ;
: UNDO 0 STROBE C! ;
: CURSOR 96 EMIT 8 EMIT ;
: DOIT UNDO EMIT CURSOR ;

: KB BEGIN KEYBOARD DUP
ESCAPE = NOT WHILE DUP
 127 >  IF          UNDO
 ELSE DROP                    ENDIF
REPEAT  UNDO ;

-->

( #84 LOWER CASE 2 )

: LOWER CURSOR UNDO BEGIN KEYBOARD
DUP
ESCAPE = NOT WHILE  DUP
 RETURN = NOT IF DUP
  128 < NOT IF DUP
   193 < NOT IF DUP
    218 > NOT IF
     32 +  DOIT
    ELSE DOIT                    ENDIF
   ELSE DOIT                     ENDIF
  ELSE DROP                      ENDIF
 ELSE 160 EMIT DOIT              ENDIF
REPEAT UNDO ;

-->

( #85 LOWER CASE 3 )

: CASES CR CURSOR DROP BEGIN KEYBOARD
DUP
143 =  NOT WHILE DUP
 RETURN = NOT IF DUP
  128 < NOT IF DUP
   ESCAPE =  IF DUP   LOWER
   ELSE DOIT                 ENDIF
  ELSE DROP                  ENDIF
 ELSE 160 EMIT DOIT          ENDIF
REPEAT UNDO ;
HOME CASES
```

Some explanatory notes on the programmes

Screen #91
'RESULTS' clears the screen with the word HOME and then invokes words which evaluate the mean and variance. I sometimes like to define variables in brackets, thus – (VARIANCE) – to distinguish them from words which define actions. The word 'FORMULA' defines a calculation which 'SIGMA' is to use recursively to find the square root of the variance. (VARIANCE) itself is a 32-bit variable and this explains words such as 2! to store it, and 2@, to fetch it. If you want to add a 16-bit variable to a 32-bit variable you need a 'single-to-double' conversion word S—>D. I give an example



```
0 VARIABLE SINGLE (DEFINES A 16-BIT
VARIABLE CALLED 'SINGLE')
0. 2VARIABLE DOUBLE (DEFINES A 32-BIT
VARIABLE CALLED 'DOUBLE')
123456. DOUBLE 2! (STORES A VALUE IN
'DOUBLE')
2345 SINGLE ! (STORES 16-BIT NUMBER)
: ANSWER DOUBLE 2@ (FETCHES 'DOUBLE')
SINGLE@ (FETCHES 'SINGLE') S->D (CON-
VERTS IT TO 32 BIT) D+ (ADDS TWO 32-BIT
NUMBERS) D. (PRINTS THE ANSWER) ;
ok
ANSWER 125801 OK
```

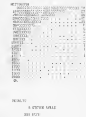
```
( [illegible] )
0 VARIABLE [illegible]
21 [illegible]
: ASSIGNMENT 21 0 [illegible] (NOMINAL [illegible]
10 * + [illegible] I [illegible] LOOP ;
: STATED (NOMINAL [illegible] ASSIGNMENT ;
: PUT DUP 0 AS [illegible] NOT IF DUP 0
[illegible] @ < NOT IF DUP 21 0
DO DUP (NOMINAL) @ [illegible] I 1 + 1000 */
> NOT IF I 1 BIN +! LEAVE ENDIF LOOP
DROP ELSE ." TOO SMALL" ENDIF ELSE
." TOO BIG" ENDIF DROP ;
 : CLEAR 21 0 DO 0 I BIN ! LOOP ; CLEAR
: HISTOGRAM 21 0 DO CR I ASSIGN @
4 .R 34 0 DO ." |" SPACE 2 +LOOP CR I
UP 4 RIGHT
I BIN @ DUP 0= NOT IF 0 DO ." )"
LOOP ELSE DROP ENDIF I BIN @ DUP 0= NOT
IF CR I UP 35 RIGHT 2 .R ELSE DROP
ENDIF LOOP CR ;
: SUM 0 21 0 DO I BIN @ I ASSIGN @ M*
D+ LOOP ;
-->

( 90 HISTOGRAM 2   30/10/80 )
: ALL 0 21 0 DO I BIN @ + LOOP ;

0 VARIABLE (MEAN) 0. 2VARIABLE
(VARIANCE)
: MEAN SUM ALL M/ SWAP 2 * ALL
< NOT IF 1+ ENDIF (MEAN) ! ;

: J R> R> R> I SWAP >R SWAP >R SWAP >R ;

: VARIANCE 0. 21 0 DO I ASSIGN @ (MEAN)
@ - DUP M* I BIN @ D* D+
LOOP ALL M/MOD ROT DROP (VARIANCE) 2!
;

 INPUT HOME 20 0 DO CR QUERY INTERPRET
PUT LOOP HOME ." HOME? TYPE 'INPUT'" CR
CR ." OR TYPE [illegible] ISTOGRAM'." CR
." OR 'RESULTS' TO SEE HOW ITS GOING." ;

 START 21 0 DO 0 I BIN ! LOOP
 0 STATED .
-->
```

```
( STD DEVIATION AND VARIANCE DEFINITION )

0 VARIABLE TRIAL

: FORMULA (VARIANCE) 2@
 TRIAL @ M/MOD
ROT 2 * TRIAL @ < NOT IF 1. D+ ENDIF
TRIAL @ S->D D+ 2 M/ TRIAL ! DROP ;

: SIGMA (VARIANCE) 2@ 10 M/ TRIAL ! DROP
 10 0 DO FORMULA LOOP TRIAL @ ;
: COV SIGMA 1000 (MEAN) @ */ ;

: RESULTS FAC MEAN VARIANCE
 CR CR ." RESULTS " CR CR
 MAXTAB 9 .R ."  STATED VALUE"
 CR CR (MEAN) @ 9 .R ."  MEAN" CR CR
(VARIANCE) 2@ 9 D.R ."  VARIANCE" CR CR
 SIGMA 9 .R ."  STANDARD DEVIATION" CR
CR CR COV 9 .R ."  COEFFICIENT OF VARIATION
 " CR ."  (TIMES 10)" CR CR
;


( FOR INSTRUCTIONS FOR HISTOGRAM )
 : DOPE PAGE
 ." 1. MEASURE THE OHMIC RESISTANCES OF
CR
2. ENTER THE VALUES INTO THE COMPUTER "
  CR ." TO DO THIS, TYPE 'INPUT' AND HIT
RETURN" CR ." ENTER THE VALUES , H
ITTING RETURN AFTER EACH. YOU WILL TH
EN BE ASKED IF " ." YOU WANT MORE. IF Y
OU DO, TYPE 'INPUT'" CR ." AGAIN AND
CONTINUE UNTIL YOU HAVE REACHE
D 100. IF YOU HAVE " CR ." CR
." THEN," CR CR ." 3. TYPE 'SHAPE' OR"
CR CR ." 4. TYPE 'HISTOGRAM'" CR "
AND FINALLY," CR CR ." 5. TYPE 'RESULTS'
." CR CR
 ." TYPE 'DOPE' IF YOU WANT THE INSTRUCT
IONS AGAIN. TYPE 'SCRAP' IF YOU WANT TO S
TART AGAIN" ;
STATISTICS-SCH

      ** HISTOGRAM EXPERIMENT **

IN WHAT FOLLOWS, COMMANDS WHICH YOU HAVE
TO TYPE ARE WRITTEN IN SINGLE QUOTES
LIKE THIS,
            'INPUT'.
                          YOU TYPE THE WORD
(BUT NOT THE QUOTES!). HITTING THE RET
URN KEY COMPLETES THE ENTRY
```

FORTH Series

```
YOU START THIS PROGRAMME BY ENTERING THE
STATED VALUE OF THE RESISTORS WITH THIS
COMMAND
              'N STATED'.
   E.G  1500 STATED.
HAVING DONE THIS TYPE THE COMMAND
                 'DOPE'
FOR MORE INSTRUCTIONS.
```

HISTOGRAM



```
RESULTS

        0 STATED VALUE

      250 MEAN

    68744 VARIANCE

      290 STANDARD DEVIATION

     1006 COEFFICIENT OF VARIATION
                                 (TIMES 10)
```

Screen #90

INPUT' allows 20 values to be entered before asking if more are required. QUERY causes the system to hang, waiting for a keyboard entry which is then interpreted before carrying on with the next word. 'ASSIGN' is an array of 1 percent intervals evaluated by the word 'ASSIGNMENT' defined earlier.

Screen #89

This is more or less self-explanatory. The array BIN corresponds to ASSIGN and simply specifies the number of resistors to a particular percentile.

For instructional purposes I have added a screen #94 which shows how mean and standard deviation compare for an exponential distribution generated by random numbers, the programme for which has appeared in an earlier issue.

Now for a news item. A newly formed FORTH Interest Group (UK) meets at the Polytechnic of the South Bank in room 428 (the Seminar Room) on the first Thursday of each even-numbered month at 7 p.m. Anyone interested will be welcomed. The nearest railway stations are Waterloo and London Bridge and the nearest tube station is Elephant and Castle. ■

- *Gil Filbey lectures in Physics at the Polytechnic of the South Bank, London.*

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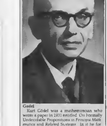
THE EXCELLENCE OF EGOTISM

Editor's note *This extract, quarried from the inexhaustible mine of Hofstadter's master work* **Godel Escher Bach** *(a Pulitzer Prize winner) is by arrangement with the publishers of the hardback edition in Britain* **Harvester Press**. *Our thanks to* **Penguin Books,** *who have just published the softback edition, for its cooperation in supplying the cover illustration. The hardback edition makes a splendid gift, the softback edition makes a splendid personal copy.*



Godel

Kurt Gödel was a mathematician who wrote a paper in 1931 entitled On Formally Undecidable Propositions in *Principia Mathematica* and Related Systems. In it he formulates a proposition around which Hofstadter makes much of his argument revolve — All consistent axiomatic formulations of number theory include undecidable propositions. This theorem had an electrifying effect on logicians, mathematicians and philosophers, for it showed that no fixed system, no matter how complicated, could represent the complexity of whole numbers. A world of paradox and so-called Strange Loops was opened up, a world fully explored by Hofstadter in his book. ●

What is recursion? It is nesting, and variations on nesting. The concept is very general. (Stones inside stones, movies inside movies, paintings inside paintings, Russian dolls inside Russian dolls (even parenthetical comments inside parenthetical comments!)— these are just a few of the charms of recursion.)

Sometimes recursion seems to brush paradox very closely. For example, there are *recursive definitions*. Such a definition may give the casual viewer the impression that something is being defined in terms of *itself*. That would be circular and lead to infinite regress, if not to paradox proper. Actually, a recursive definition (when properly formulated) never leads to infinite regress or paradox. This is because a recursive definition never defines something in terms of itself, but always in terms of *simpler versions* of itself. What I mean by this will become clearer shortly, when I show some examples of recursive definitions.

One of the most common ways in which recursion appears in daily life is when you postpone completing a task in favour of a simpler task, often of the same type. Here is a good example. An executive has a fancy telephone and receives many calls on it. He is talking to A when B calls. To A he says, "Would you mind holding for a moment?" Of course he doesn't really care if A minds, he just pushes a button, and switches to B. Now C calls. The same deferment happens to B. This could go on indefinitely, but let us not get too bogged down in our enthusiasm. So let's say the call with C terminates. Then our executive "pops" back to B, and continues. Meanwhile, A is sitting at the other end of the line, drumming his fingernails against some table, and listening to some horrible Muzak piped through the phone line to placate him. Now the easiest case is if the call with B simply terminates, and the executive returns to A finally. But *it could* happen that after the conversation with B is resumed, a new caller—D—calls. B is once against pushed onto the stack of waiting callers, and D is taken care of. After D is done, back to B, then back to A. This executive is hopelessly mechanical, to be sure—but we are illustrating recursion in its most precise form. In the preceding example, I have introduced some basic terminology of recursion—at least as seen through the eyes of computer scientists. The terms are *push*, *pop* and *stack* (or *push-down stack*, to be precise) and they are all related. They were introduced in the late 1950's as part of IPL, one of the first languages for Artificial Intelligence. You have already encountered "push" and "pop" in the Dialogue. But I will spell things out anyway. To *push* means to suspend operations on the task you're currently working on, without forgetting where you are—and to take up a new task. The new task is usually said to be "on a lower level" than the earlier task. To *pop* is the reverse—it means to close operations on one level and to resume operations exactly where you left off, one level higher.

But how do you remember exactly where you were on each different level? The answer is, you store the relevant information in a *stack*. So a stack is just a table telling you such things as (1) where you were in each unfinished task (jargon: the "return address"), (2) what the relevant facts to know were at the points of interruption (jargon: the "variable bindings"). When you pop back up to resume some task, it is the stack which restores your context, so you don't feel lost. In the telephone-call example, the stack tell you *who* is waiting on each different level, and *where* you were in the converetion when it was interrupted.

By the way, the terms "push", "pop", and "stack" all come from the visual image of cafeteria trays in a stack. There is usually some sort of spring underneath which tends to keep the topmost tray at a constant height, more or less. So when you push a tray onto the stack, it sinks a little—and when you remove a tray from the stack, the stack pops up a little.

One more example from daily life. When you listen to a news report on the radio, oftentimes it happens that they switch you to some foreign correspondent. "We now switch you to Sally Swumpley in Peafog, England." Now

Sally has got a tape of some local reporter interviewing someone, so after giving a bit of background, she plays it I'm Nigel Cadwallader, here on scene just outside of Peafog where the great robbery took place, and I'm talking with Now you are three levels down It may turn out that the interviewee also plays a tape of some conversation It is not too uncommon to go down three levels in real news reports, and surprisingly enough, we scarcely have any awareness of the suspension It is all kept track of quite easily by our subconscious mind Probably the reason it is so easy is that each level is extremely different in flavor from each other level If they were all similar, we would get confused in no time flat

Recursion in Language

Our mental stacking power is perhaps slightly stronger in language The grammatical structure of all languages involves setting up quite elaborate push-down stacks though, to be sure, the difficulty of understanding a sentence increases sharply with the number of pushes onto the stack The proverbial German phenomenon of the "verb-at the-end", about which droll tales of absentminded professors who would begin a sentence, ramble on for an entire lecture, and then finish up by rattling off a string of verbs by which their audience, for whom the stack had long since losts its coherence would be totally nonplussed are told, is an excellent example of linguistic pushing and popping The confusion among the audience that out-of-order popping from the stack onto which the professor's verbs had been pushed, is amusing to imagine, could engender But in normal spoken German, such deep stacks almost never occur—in fact, native speakers of German often unconsciously violate certain conventions which force the verb to go to the end in order to avoid the mental effort of keeping track of the stack Every language has constructions which involve stacks, though usually of a less spectacular nature than German But there are always ways of rephrasing sentences so that the depth of stacking is minimal

Recursive Transition Networks

The syntactical structure of sentences affords a good place to present a way of describing recursive structures and processes the *Recursive Transition Network* (RTN) An RTN is a diagram showing various paths which can be followed to accomplish a particular task Each path consists of a number of *nodes* or little boxes with words in them joined by *arcs* or lines with arrows The overall name for the RTN is written separately at the left and the first and last nodes have the words *begin* and *end* in them All the other nodes contain either very short explicit directions to perform, or else names of other RTN's Each time you hit a node you are to carry out the directions inside it or to jump to the RTN named inside it, and carry it out

Let's take a simple RTN called ORNATE NOUN which tells how to construct a certain type of English noun phrase (See Figure 1a) If we traverse ORNATE NOUN purely horizontally, we *begin* then we create an ARTICLE, an ADJECTIVE and a NOUN then we *end* For instance "the silly shampoo" or a thankless brunch" But the arcs show other possibilities such as skipping the article, or repeating the adjective Thus we could construct "milk or "big red blue green sneezes etc

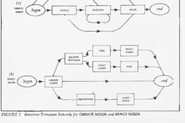


FIGURE 1 Recursive Transition Networks for ORNATE NOUN *and* FANCY NOUN

When you hit the node NOUN you are asking the unknown black box called NOUN to fetch any noun for you from its storehouse of nouns This is known as a *procedure call*, in computer science terminology It means you temporarily give control to a *procedure* (here NOUN) which (1) does its thing (produces a noun) and then (2) hands control back to you In the above RTN, there are calls on three such procedures ARTICLE ADJECTIVE, and NOUN Now the RTN ORNATE NOUN could itself be called from some other RTN—for instance an RTN called SENTENCE In this case ORNATE NOUN would produce a phrase such as the silly shampoo' and then return to the place inside SENTENCE from which it had been called It is quite reminiscent of the way in which you resume where you left off in nested telephone calls or nested news reports

However, despite calling this a 'recursive transition network, we have not exhibited any true recursion so far Things get recursive—and seemingly circular—when you go to an RTN such as the one in Figure 1b for FANCY NOUN As you can see, every possible pathway in FANCY NOUN involves a call on ORNATE NOUN, so there is no way to avoid getting a noun of some sort or other And it is possible to be no more ornate than that coming out merely with milk' or 'big red blue green sneezes' But three of the pathways involve *recursive* calls on FANCY NOUN itself It certainly looks as if something is being defined in terms of itself Is that what is happening, or not?

The answer is "yes but benignly Suppose that in the procedure SENTENCE, there is a node which calls FANCY NOUN and we hit that node This means that we commit to memory (viz the stack) the location of that node inside SENTENCE we we'll know where to return to—then we transfer our attention to the procedure FANCY NOUN Now we must choose a pathway to take in order to generate a FANCY NOUN Suppose we choose the lower of the upper pathways—the one whose calling sequence goes

ORNATE NOUN RELATIVE PRONOUN FANCY NOUN, VERB

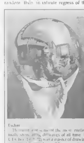
So we spit out an ORNATE NOUN *the strange bagels*, a RELATIVE PRONOUN that and now we are suddenly asked for a FANCY NOUN But we are in the middle of FANCY NOUN! Yes, but remember our executive who was in the middle of one phone call when he got another one He merely stored the old phone call's status on a stack, and began the new one as if nothing were unusual So we shall do the same

We first write down in our stack the node we are at in the outer call on FANCY NOUN, so that we have a return address, then we jump to the beginning of FANCY NOUN as if nothing were unusual Now we have to choose a pathway again For variety's sake let's choose the lower pathway: ORNATE NOUN, PREPOSITION, FANCY NOUN. That means we produce an ORNATE NOUN (say *the purple cow*), then a PREPOSITION (say *without*), and once again we hit the recursion. So we hang onto our hats and descend one more level. To avoid complexity, let's assume that this time, the pathway we take is the direct one—just ORNATE NOUN. For example we might get *horns*. We hit the node END in this call on FANCY NOUN, which amounts to popping out, and so we go to our stack to find the return address. It tells us that we were in the middle of executing FANCY NOUN one level up—and so we resume there. This yields *the purple cow without horns*. On this level, too, we hit END, and so we pop up once more, this time finding ourselves in need of a VERB—so let's choose *gobbled*. This ends the highest-level call on FANCY NOUN, with the result that the phrase

the strange bagels that the purple cow without horns gobbled

will get passed upwards to the patient SENTENCE as we pop for the last time.

As you see, we didn't get into any infinite regress. The reason is that at least one pathway inside the RTN FANCY NOUN does *not* involve any recursive calls on FANCY NOUN itself. Of course we could have perversely insisted on always choosing the bottom pathway inside FANCY NOUN, and then we would never have gotten finished, just as the acronym "GOD" never got fully expanded. But if the pathways are chosen at random, then an infinite regress of that



Escher

He created some of the most intellectually stimulating drawings of all time. M. C. Escher (1898-1972) was a master of drawing recursive figures. His well known patterns of birds and fish, strange waterfalls and staircases that lead up back where they began can be found widely reproduced in print shops. In Hofstadter the picture by Escher [illegible] has all the [illegible] elements of a strange loop. The book also draws out the link which Escher's drawings have with Zen koans.

sort will not happen.

"Bottoming Out" and Heterarchies

This is the crucial fact which distinguishes recursive definitions from circular ones. There is always some part of the definition which avoids self-reference, so that the action of constructing an object which satisfies the definition will eventually "bottom out".

Now there are more oblique ways of achieving recursivity in RTN's than by self-calling. There is the analogue of Escher's *Drawing Hands*, where each of two procedures calls the other, but not itself. For example, we could have an RTN named CLAUSE, which calls FANCY NOUN whenever it needs an object for a transitive verb, and conversely, the upper path of FANCY NOUN could call RELATIVE PRONOUN and then CLAUSE whenever it wants a relative clause. This is an example of *indirect* recursion. It is reminiscent also of the two-step version of the Epimenides paradox.

Needless to say, there can be a trio of procedures which call one another, cyclically—and so on. There can be a whole family of RTN's which are all tangled up, calling each other and themselves like crazy. A program which has such a structure in which there is no single "highest level" or "monitor", is called a *heterarchy* (as distinguished from a hierarchy). The term is due, I believe, to Warren McCulloch, one of the first cyberneticists and a reverent student of brains and minds.

Expanding Nodes

One graphic way of thinking about RTN's is this. Whenever you are moving along some pathway and you hit a node which calls on an RTN, you "expand" that node, which means to replace it by a very small copy of the RTN it calls (see Fig. 2). Then you proceed into the very small RTN!

When you pop out of it, you are automatically in the right place in the big one. While in the small one, you may wind up constructing even more miniature RTN's. But by expanding nodes only when you come across them, you avoid the need to make an infinite diagram even when an RTN calls itself.

Expanding a node is a little like replacing a letter in an acronym by the word it stands for. The "GOD" acronym is recursive but has the defect—or advantage—that you must repeatedly expand the 'G'; thus it never bottoms out. When an RTN is implemented as a real computer program, however, it always has at least one pathway which avoids recursivity (direct or indirect) so that infinite regress is not created. Even the most heterarchical program structure bottoms out—otherwise it couldn't run! It would just be constantly expanding node after node, but never performing any action.

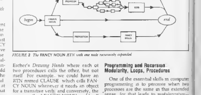


FIGURE 2 The FANCY NOUN *RTN with one node recursively expanded*

Programming and Recursion: Modularity, Loops, Procedures

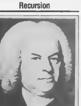
One of the essential skills in computer programming is to perceive when two processes are the same in this extended sense, that leads to *modularization*—the breaking-up of a task into natural subtasks. For instance, one might want a sequence of many similar operations to be carried out one after another. Instead of writing them all out, one can write a *loop*, which tells the computer to perform a fixed set of operations and then loop back and perform them again, over and over, until some condition is satisfied. Now the *body* of the loop—the fixed set of instructions to be repeated—need not actually be completely fixed. It may vary in some predictable way.

An example is the most simple-minded test for the primality of a natural number *N*, in which you begin by trying to divide *N* by 2, then by 3, 4, 5, etc. until $N-1$. If *N* has survived all these tests without being divisible, it's prime. Notice that each step in the loop is similar to, but not the same as, each other step. Notice also that the number of steps varies with *N*—hence a loop of fixed length could never work as a general test for primality. There are two criteria for "aborting" the loop: (1) if some number divides *N* exactly, quit with answer "NO"; (2) if $N-1$ is reached as a test divisor and *N* survives, quit with answer "YES".

The general idea of loops then is this: perform some series of related steps over and over, and abort the process when specific conditions are met. Now, sometimes the maximum number of steps in a loop will be known in advance; other times you just begin and wait until it is aborted The second type of loop which I call a *free* loop—is dangerous, because the criterion for abortion may never occur leaving the computer in a so-called "infinite loop" This distinction between *bounded loops* and *free loops* is one of the most important concepts in all of computer science and we shall devote an entire Chapter to it "BlooP and FlooP and GlooP"

Now loops may be nested inside each other For intance suppose that we wish to test all the numbers between 1 and 5000 for primality We can write a second loop which uses the above-described test over and over starting with $N = 1$ and finishing with $N = 5000$ So our program will have a "loop-the-loop" structure Such program structures are typical—in fact they are deemed to be good programming style This kind of nested loop also occurs in assembly instructions for commonplace items, and in such activities as knitting or crocheting—in which very small loops are repeated several times in larger loops, which in turn are carried out repeatedly While the result of a low-level loop might be no more than couple of stitches the result of a high-level loop might be a substantial portion of a piece of clothing

In music too nested loops often occur—as, for instance when a scale (a small loop) is played several times in a row perhaps displaced in pitch each new time For example the last movements of both the Prokofiev fifth piano-concerto and the Rachmaninoff second symphony contain extended passages in which fast medium and slow scale loops are played simultaneously by different groups of instruments to great effect The Prokofiev-scales go up, the Rachmaninoff scales down. Take your pick



Bach

The great and widely known composer was also the master of the canon Hofstadter draws heavily on the canonic writing of The Musical Offering, composed for Frederick the Great and in particular on the RICECAR (Italian to seek) a particularly erudite form of fugue These forms are used as models to produce dialogues between a number of characters that the author brings into play and the whole work concludes (as does Bach's own canonic writing) "The Musical Offering is a fugue of fugues a Tangled Hierarchy like those of Escher and Gödel an intellectual construction which reminds me in ways I cannot express of the beautiful many voiced fugue of the human mind And that is why in my book the three strands of Gödel, Escher and Bach are woven into an Eternal Golden Braid ●

A more general notion than loop is that of *subroutine*, or *procedure*, which we have already discussed somewhat The basic idea here is that a group of operations are lumped together and considered a single unit with a name—such as the procedure ORNATE NOUN As we saw in RTN's procedures can call each other by name and thereby express very concisely sequences of operations which are to be carried out This is the essence of modularity in programming Modularity exists, of course, in hi-fi systems furniture living cells human society—wherever there is hierarchical organization

More often than not, one wants a procedure which will act variably, according to context Such a procedure can either be given a way of peering out at what is stored in memory and selecting its actions accordingly, or it can be explicitly fed a list of *parameters* which guide its choice of what actions to take Sometimes both of these methods are used In RTN terminology choosing the sequence of actions to carry out amounts to *choosing which pathway to follow* An RTN which has been souped up with parameters and conditions that control the choice of pathways inside it is called an *Augmented Transition Network* (ATN) A place where you might prefer ATN's to RTN's is in producing sensible—as distinguished from nonsensical—English sentences out of raw words according to a grammar represented in a set of ATN's The parameters and conditions would allow you to insert various semantic constraints so that random juxtapositions like "a thankless brunch" would be prohibited More on this in Chapter XVIII however

Recursion in Chess Programs

A classic example of a recursive procedure with parameters is one for choosing the "best" move in chess The best move would seem to be the one which leaves your opponent in the toughest situation Therefore a test for goodness of a move is simply this pretend you've made the move and now evaluate the board from the point of view of your opponent But how does your opponent evaluate the position? Well he looks for *his* best move That is he mentally runs through all possible moves and evaluates them from what he thinks is *your* point of view hoping they will look bad to you But notice that we have now defined "best move" recursively simply using the maxim that what is best for one side is worst for the other The recursive procedure which look for the best move operates by trying a move and then *calling on itself in the role of opponent!* As such it tries another move and calls on itself in the role of its opponent's opponent—that is itself

This recursion can go several levels deep but it's got to bottom out somewhere! How do you evaluate a board position *without* looking ahead? There are a number of useful criteria for this purpose such as simply the number of pieces on each side the number and type of pieces under attack the control of the center and so on By using this kind of evaluation at the bottom the recursive move generator can pop back upwards and give an evaluation at the top level of each different move One of the parameters in the self calling then must tell how many moves to look ahead The outermost call on the procedure will use some externally set value for this parameter Thereafter each time the procedure recursively calls itself it must decrease this look-ahead parameter by 1 That way when the parameter reaches zero the procedure will follow the alternate pathway—the non recursive evaluation

In this kind of game playing progam each move investigated causes the generation of a so called "look ahead tree" with the move itself as trunk responses as main branches counter responses as subsidiary branches and so on In Figure 3 I have shown a simple look ahead tree

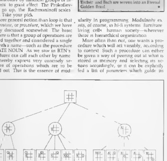


FIGURE 3 The branching tree of move and countermoves at the start of a game of tic tac toe

Recursion

The author
Douglas R. Hofstadter, son of the well-known physicist, Richard Hofstadter, was born in 1945 in New York City but grew up mostly in California, with the exception of a year spent in Geneva where he learnt to speak French and began his interest in languages. As a child he was fascinated by physical apparatus and the ideas of physics and mathematics. In high school and college he pursued his scientific and linguistic interests and developed some artistic interests. Music also entered his life in a profound way and he discovered a deep love for many composers, especially Chopin and Bach. In 1965-6 he spent another year in Europe, returning to the United States to undertake graduate studies in mathematics at Berkeley, California. However, finding mathematics too abstract and confining, he swerved in his career and headed off in early 1968 to the University of Oregon, where he began graduate work in theoretical physics and was awarded his Ph D in 1975. Since 1977 Douglas Hofstadter has been Assistant Professor of Computer Science at Indiana University, a post which has enabled him to pursue many of the ideas expressed in this book. In 1980 he won the Pulitzer Prize for general non-fiction with *Gödel Escher Bach*.
He is currently in California, teaching at Stanford University.

depicting the start of a tic-tac-toe game. There is an art to figuring out how to avoid exploring every branch of a look-ahead tree out to its tip. In chess trees, people—not computers—seem to excel at this art; it is known that top-level players look ahead relatively little, compared to most chess programs—yet the people are far better! In the early days of computer chess, people used to estimate that it would be ten years until a computer (or program) was world champion. But after ten years had passed, it seemed that the day a computer would become world champion was still more than ten years away. This is just one more piece of evidence for the rather recursive—

Hofstadter's Law: It always takes longer than you expect, even when you take into account Hofstadter's Law.

Recursion and Unpredictability

Now what is the connection between the recursive processes of this Chapter, and the recursive sets of the preceding Chapter? The answer involves the notion of a *recursively enumerable set*. For a set to be r.e. means that it can be generated from a set of starting points (axioms), by the repeated application of rules of inference. Thus, the set grows and grows, each new element being compounded somehow out of previous elements, in a sort of "mathematical snowball". But this is the essence of recursion—something being defined in terms of simpler versions of itself, instead of explicitly. The Fibonacci numbers and the Lucas numbers are perfect examples of r.e. sets—snowballing from two elements by a recursive rule into infinite sets. It is just a matter of convention to call an r.e. set whose complement is also r.e. "recursive".

Recursive enumeration is a process in which new things emerge from old things by fixed rules. There seem to be many surprises in such processes. It might seem that recursively defined sequences of that type possess some sort of inherently increasing complexity of behaviour, so that the further out you go, the less predictable they get. This kind of thought carried a little further suggests that suitably complicated recursive systems might be strong enough to break out of any predetermined patterns. And isn't this one of the defining properties of intelligence? Instead of just considering programs composed of procedures which can recursively *call* themselves, why not get really sophisticated, and invent programs which can *modify* themselves—programs which can act on programs, extending them, improving them, generalizing them, fixing them, and so on? This kind of "tangled recursion" probably lies at the heart of intelligence. ■

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BRAND NEWs compiled by Microspy with Anthony Esgate

14

This middle section may either be pulled out or photocopied then filed for reference It will be comprehensive and range over the whole field of products services events and courses **PU** stands for Personal User **SB** stands for small base – that is small budget or small business **MB** – medium base medium budget or medium business **BB** – big base big budget or big business **Addresses** are to be found at the end of **Brand News.**

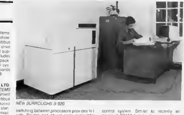
Systems

ABS COMPUTERS
ABS COMPUTERS MX Series systems launched at Which? Computer show based on proven successful Multibus technology Classified by type of disc drive rather than CPU power and peripheral support capabilities Multibus software includes CAP integrated ledger accounting package ManuMark manufacturing control systems and the PAIRS incomplete records package for accounting practices *MB*

BLEASDALE COMPUTER SYSTEMS LTD
BLEASDALE COMPUTER SYSTEMS LTD MDS Microprocessor Development System Uses industry standard Multibus compatible printed circuit modules Housed in a case which can be mounted into standard 19" racks Input/output facilities available enable MDS to be interfaced to devices and transducers which it can control and monitor In circuit emulator under development Supports 8-bit and 16-bit microprocessors and has maximum memory capacity of 1 megabyte 8080 8085 Z80 (under CP/M) and 6809 supported Software for 16-bit micros is Unix operating system *SYSTEMS DESIGNERS EDUCATIONAL*

BRITANNIA COMPUTER SYSTEMS LTD
BRITANNIA COMPUTER SYSTEMS LTD MICROWORD dual purpose microcomputer designed for both data and word processing applications Floppy or hard disc drives standard or intelligent VDUs letter quality or fast matrix printers available Applications packages in Business BASIC or microCOBOL include CAP microCOBOL business packages and own Word Processing Package *MB*

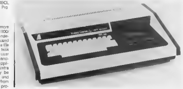
BURROUGHS B900
BURROUGHS B900 Designed to more than fill the gap between B90 and B1800/2900 systems Incorporates up to 8 independent B90 function processors 5 used in basic system operating control data file management 2 multi programming task processors to compile and execute user programs and data communications handler Extra processors handle specific applications or increase power to cater for extra workloads Each task processor may be doubled from 128Kbytes to 256Kbytes and total system memory expanded from 640Kbytes to 1 5 million bytes Up to 2 processors can handle data communications making total bandpass 192000 BPS Inter switching between processors provides fail safe Source and object code compatible with existing screen based CMS (Computer Management System) devices (B80 B90 B800) All members of proven range of screen based software products available with B900 Incorporates new Burroughs Winchester technology fixed disk drives 40 & 50 MB versions with data transfer rates of 7 1 million bits/second 300 and 500 line/minute printers available First model in range is B920 screen based system designed for a broad range of commercial stand alone and distributed processing applications From £35000 typical configuration *MB BB*



NEW BURROUGHS B 920

BURR BROWN INTERNATIONAL LTD
BURR BROWN INTERNATIONAL LTD CS430 programmable data acquisition and control system Similar to recently announced CS450 but employs cassette instead of floppy disk Comprises microcomputer RAM peripheral interfaces Multibus compatible I/O bus and resident software *INDUSTRIAL*

CAMBRIDGE MICRO COMPUTERS LTD
CAMBRIDGE MICRO COMPUTERS LTD market Video Genie EG3000 series Z80 based microcomputer systems Ideally suited to industrial and educational applications Plugs into video monitor or UHF television receiver Power supply UHF modulator and cassette tape unit included 16K user RAM plus 12K of Microsoft BASIC in ROM 51 key typewriter style keyboard with 10 key rollover facility £330 plus VAT Microsoft Z80 editor/assembler package on cassette extra £24 *PU SB*



The Video Genie EG3000 Series offered with industrial and educational support by Cambridge Micro Computers Ltd

BRAND NEWs

CARDKEY

CARDKEY DIMENSION 1000 electronic access control system provides access control for organisations with up to 3000 employees Central controller monitors 3000 people through 8 terminals/card reader points Access points and alarms are directed by controller and entry/exit is governed by presentation of cardkey 4 time zones 8 access levels for personnel control 21 column printer for recording transactions 16 character LED display 72 hour battery backup for memory real time calender clock audible alarm bulk or single card loading presence on-site statements and anti pass back facility DIMENSION 2000 controls up to 4000 programmable cardkeys for use at 32 card reader points and simultaneously monitors over 700 alarm inputs Also features closed circuit TV coverage of activity at doors etc *MB BB (SECURITY)*

The new D[illegible]on 1000 ac[illegible] system [illegible] Cardkey

CELDIS

CELDIS Microsystems Division now supply Motorola's EXORset–30 development system based on MC6809 microprocessor Comprises full size ASCII keyboard with 16 user programmable function keys 22 lines by 80 columns VDU and full 320 by 256 dot graphics display integral dual mini floppy disk drives 48Kbytes of RAM and 12 sockets for up to 24Kbytes of user firmware in ROM or EPROM Software includes Motorola's EXORbug monitor and BASIC M compiler/interpreter *SYSTEMS DESIGNERS PROGRAMMERS (MC6809)*

COMPUTER AUTOMATION

COMPUTER AUTOMATION entry level SyFA system known as SyFA 100 Provides distributed processing users with an application dedicated system fully compatible with all other SYFA systems in range including SNA SDLC network processors Contained in desk unit and comprises central processor 32Kbytes of MOS memory SYFA Information Station VDU second port facility and 0 25Mbyte diskette subsystem Two dot matrix printers supporting full upper/lower case ASCII available—100 c p s 80 column table top and 180 c p s 132 column stand mounted Programmable in SyBOL making it suitable for stand alone applications such as data collection validation and processing *MB BB*

DIGITAL EQUIPMENT CORPORATION

DIGITAL EQUIPMENT CORPORATION (DEC) VAX–11/750 Industry's first custom LSI (Large Scale Integration) 32 bit minicomputer Uses gate array technology to achieve 60% of the performance of the VAX 11/780 at 40% of the CPU cost 4 3 gigabytes virtual address space 2 gigabyte maximum program size 16 32 bit general

The new[illegible]unced SyFA [illegible] from Computer Automation's C[illegible] Systems Division

registers 32 interrupt priority levels (16 each for hardware and software) 9 addressing modes and 4 hierarchical protection modes each with read write access control Real time and time-of year clocks latter with battery backup Software compatible with 780 Same 244 instruction set and VAX/VMS virtual memory operating system as /780 Both run all 32 bit VAX 11 high level languages MACRO assembly language software packages utilities and DECnet communications software as well as range of PDP 11 software in 16 bit compatibility mode VAX 11/750 includes up to 2MB ECC (error correction code) MOS main memory 4Kbyte integral cache memory TU58 DECtape II cassette drive for software updates diagnostics or auxiliary data storage integral UNIBUS interface for terminals serial devices and medium speed peripherals and 3 optional MASSBUS adaptors for high speed disk tape and other peripheral equipment CPU control of LA36 DECwriter IV console terminal for keyboard system control and online problem diagnosis In addition a fixed medium Winchester type disk unit RM80 with 124MB capacity has been introduced for use with MASSBUS equipped VAX 11 780 and 750 Average seek time 25ms average access time 33ms Data transfer rate 1 2MB/sec Simultaneously with release of VAX 11/750 DATASYSTEM 700 series of commercial computer systems has been announced which will combine VAX-11 based computer systems with commercial software (VAX 11 FMS DATATRIEVE choice of COBOL or BASIC) DATASYSTEM 750 from £72000 DATASYSTEM 780 from £155 000 *BB (VAX)*

EQUINOX COMPUTER SYSTEMS LTD

EQUINOX COMPUTER SYSTEMS LTD computer systems from £1500 to more than £10 000 including the Series 5000 Series 8000 Equinox 200 and Equinox 300 Last of these is a cartridge disc system featuring a 16 bit CPU 64–256K RAM S100 bus 6 serial ports and full multi user capacity with a choice of high level languages *SB MB*

FERRANTI

FERRANTI PT7 50 series of terminal controllers a new advanced alternative to ICL 7502 and IBM 3270 Supports up to 24 VDUs 7 printers floppy disk or up to 40 megabytes of cartridge disc Basic interactive system with 24 VDUs from £42 000 *MB BB*

GMS COMPUTING LTD

GMS COMPUTING LTD new microcomputer launched at Which? Computer Show claimed to be the most elegant design on the market Represents the hardware element in GMS's Umbrella Deal 48K expandable to 64K 1 million bytes online disk memory (standard 8" floppy disks) expandable to 2 million or 20 million bytes (hard disk) 150 c p s 132 c p l bidirectional dot matrix printer with upper/lower and double size characters 24 lines by 80 columns 12" anti-glare screen with full cursor control

The DEC DATASYSTEM 750 small business computer from Digital Equipment is based on the new VAX 11/750

BRAND NEWs

GMS microcomputer representing hardware element of Umbrella Dea

and separate keyboard Languages available for creating custom built programs include microCOBOL BASIC Pascal FORTRAN PILOT and ALGOL *SB MB*

HAWKER SIDDELEY

HAWKER SIDDELEY SEQUEL microprocessor system Features online editing of systems programs programming terminal independence and improved 3 term control capability (allowing independent control and adjustment of set point and gain of proportional integral and derivative terms Applications have varied from data logging and trend analysis to fluidised bed furnace control for sludge disposal *MB BB (Scientific/Technical)*

HONEYWELL

HONEYWELL DSA Distributed Systems Architecture defines a set of rules protocols and interfaces for both system and network architecture Consistent with ISO (International Standards Organisation) reference model Supports X.25 packet switched and X.21 circuit switched network interface protocol for data communications between intelligent entities in private networks Will be employed by Honeywell to support the information distribution networks of the 80s and beyond *BB*

HOSKYNS

HOSKYNS SUPERTUFFY microcomputer based Front Office System for hotels Contains four main elements guest accounting system with alphabetic entry facilities comprising processor printer and VDU point of sale terminal network which can be connected to the system for direct entry of charges from bars restaurant etc telephone logging system and an advance reservation system Prints out high quality guest bill with itemised charges and facilities exist for production of inclusive terms analysis guest and departure list room status lists room/sleeper sales statistics and VAT analysis *MB BB (Hotels)*

KARLIN

KARLIN ATLAS family of minicomputers based on DEC LSI-11/2 and /23 microprocessors being offered as a complete solution to OEMs Smallest table top Atlas 723A costs from £6750 whilst the largest Atlas 736 costs from £14 650 A new multi user real-time operating system KOS-11 has been introduced to complement the hardware *MB OEMs*

KIRBY-LESTER

KIRBY LESTER KLone system "provides a long distance or local communication network information storage and powerful computing facilities all based on terminals with access to the Prestel information system" Full Prestel service plus computing functions with double disk drive 32K RAM expandable to 64K Z80 and printout facilities Cost of linking 5 geographical locations by interconnecting their Kirby Lester PCT 14 Prestel terminals with KLone computer based at one of them about £14 000 *MB BB*

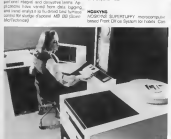
The System M Two small business computer from LSI Computers Ltd

LSI COMPUTERS LTD

LSI COMPUTERS LTD SYSTEM M TWO based on Intel 8085 processor plus address relocation 64K dynamic RAM with additional banks of 64K available plus 4K PROM Two Shugart double density disk drives of 600KB and a Shugart Winchester fixed disk drive of from 5 33MB to 58MB Up to 4 VDU ports (RS232 plus 20mA current loop) for Pentland Model VI VDUs and one or two Centronics 180 c p s matrix printers (daisy wheel printers available) Communication systems to connect remote Pentlands or interlink M Twos together Applications packages include ledgers stock control invoicing order processing payroll etc From £7900 to £15 000 *MB OEM*

MERCATOR MANAGEMENT CONSULTANTS

MERCATOR MANAGEMENT CONSULTANTS SNAP microcomputer based system



The Honeywell Distributed System Satellite (DSS) is an entry-level satellite processor for use in the DSA (Distributed Systems Architecture) network for analysing data collected from surveys. Designed by market researchers ideal for surveys between 100 and 2000 questionnaires. £4950 for hard and software. *Market Researchers*

RAGEN INTERNATIONAL LTD
RAGEN INTERNATIONAL LTD UK distributors for Ai Electronics Corp of Japan ABC 20 range of microcomputers. Top of range is ABC 24 with 64K RAM and Z80A CPU, integral 12" screen and dual floppy disk drives, detachable keyboard and 4 I/O ports (input/output). Runs under CP/M, MP/M, DOSKET, UCSD Pascal with BASIC-80, MBASIC, COBOL-80, PL/3, FORTRAN IV etc. From £3000. *SB*

ABC 24 from RAGEN International

SECURED COMPUTER LTD
SECURED COMPUTER LTD The Secretary Word Processing system simple enough to be used by anyone in the office. Keyboard includes all functions in the machine. Contains up to 8 pages of memory. Daisy wheel printer produces letter quality documents. *SB MB*

WOOTTON, JEFFREYS & PARTNERS
WOOTTON JEFFREYS & PARTNERS in conjunction with URBIS Planning Design Group PLANET minicomputer based system for planning authorities which combines word processing with specially designed planning functions. Typically based on DEC PDP 11-23 features automatic printing of standard paperwork, compilation of reports and the production of management information summaries. Rental from £900 per month. *Planning Authorities*

WORDATA LTD
WORDATA LTD distributors of AM JACQUARD information processors. Packaged systems: Wordata System 100 entry level word processor consisting of screen and keyboard, dual floppy disks and correspondence quality printer. Type-Rite word processing package. From £8850. Wordata System 400 2 screen shared logic word processor with high quality printer and 12 million character hard disk. Type-Rite package. In multiple screen mode from £19 950. *MB BB*

Applications

APPLICON
APPLICON SRDC (Structural Dynamics and Research Corporation) SUPERTAB finite element modelling programs now available with Applicon CAD/CAM systems. Represents physical structures as geometric models and translates into mathematical data for static analysis programs which subject model to various stress factors to evaluate different combinations of design elements. OUTPUT DISPLAY then translates results back to graphical data for display. *MB BB (ENGINEERS)*

APPLIED DATA RESEARCH LTD
APPLIED DATA RESEARCH LTD IDEAL (Interactive Development Environment for an Application's Life Cycle) aimed at reducing the cost and level of expertise required in development of new applications. Provides interactive data dictionary directory based environment, execution and maintenance. Supported on IBM 370 303X 4300 and equivalent systems operating under DOS/VSE VS1 and MVS. *BB(IBM IBM COMPATIBLE)*

BUTEL
BUTEL PRODUCTION CONTROL SYSTEM to run on range of micros including Athena Desktop, Data General CS/10 and 30. Developed by SAFE Computing. Written in Interactive COBOL, comprises 5 modules: Bill of Materials, Inventory Management, Product Costing, Materials Planning and Work in Progress. All with access to data base. *SB MB (PRODUCTION CONTROL)*

CINCOM
CINCOM software product range for IBM 4300 4331. TOTAL database management system, ENVIRON-1 online control monitor, LMS–11 online program development system plus applications and system enhancement software. *BB(IBM 4300)*

DURHAM MICROCOMPUTER PROJECT
DURHAM MICROCOMPUTER PROJECT BASPIC graphics command language for Research Machines RML 380Z microcomputer with BASIC interpreter. Available generally to L.E.A.s and institutions at £75. Versions will be supplied for cassette based 380Z without high resolution graphics (using 9K BASIC interpreter) and mini floppy disk based 380Zs with or without high resolution graphics (using DBAS9 interpreter). *EDUCATIONAL (380Z)*

EQUINOX COMPUTER SYSTEMS LTD
EQUINOX COMPUTER SYSTEMS LTD appointed distributors of Phoenix Software Associates software. Initially available PDEVELOP suite of modules for Z80 CP/M system comprising PASM macro assembler, EDIT programmable character orientated text editor, PLINK 2 pass disc to disc linkage editor, BUG* and uBUG* interactive machine-level debuggers. Suite of four £175. *PU SB(Z80)*

1500 SYSTEMS LTD
1500 SYSTEMS LTD OMNIX multi user multi tasking Operating System for the Z80. Will run software written for CP/M as well as its own repertoire of high level languages and application packages. Devices handled by device driver routines and can be mounted anywhere within the filing system. Allows user to manipulate files as byte streams and bytes can be inserted or deleted anywhere within a file. *SB MB (Z80)*

FYLDE MICROCOMPUTER SERVICES
FYLDE MICROCOMPUTER SERVICES RCC80 CORAL Compiler available for Intel 8080 microcomputer running under ISIS and for 8080/8085/Z80 based microcomputers running CP/M. Carries IECCA approval. *MB (8080 Z80)*

GREAT NORTHERN COMPUTER SERVICES LTD
GREAT NORTHERN COMPUTER SERVICES LTD CP/M based software packages include NOMFLOW nominal ledger, PURFLOW purchase ledger, SALFLOW balance forward type sales ledger, OSLFLOW open item type sales ledger, BILLFLOW professional client billing system for accountants etc. STOCKFLOW stock control system. *MB(CP/M)*

HALLMARK COMPUTERS LTD
HALLMARK COMPUTERS LTD Integrated Suite of Applications Packages to run on Honeywell Level 6 range of minicomputers. Includes stock control, order processing, sales invoicing, sales ledger, purchase ledger and nominal ledger with budgetary control. Basic system including software 128K CPU, 20MB disc, VDU workstation and printer costs approx. £25000. *MB (HONEYWELL LEVEL 6)*

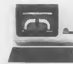
INTEX DATALOG
INTEX DATALOG PRO-KIT 1 aid to programmers of CBM 3032. Consists of suite of machine code routines residing at top of memory giving programmer fully validated general input routine, fully validated numeric routine, fully validated date routine, string search for matching sub string routine and screen exchange routine. Also a BASIC program to prepare screen displays without scrolling or accidental erasure. *SB MB (CBM 3032)*

MICRO FOCUS
MICRO FOCUS COBOL and CORAL 66 compilers now available for Apple II microcomputer – CIS COBOL and RCC 80 CORAL compiler. Run Apple II in conjunction with Z80 softcard (makes available Z80 instruction set in addition to Apple's native 6502 microprocessor). RCC80 has IECCA approval. *MB (APPLE)*

PMA CONSULTANTS
PMA CONSULTANTS in conjunction with PARRISH and FENN (The Foodfinders) FOODMASTER software package. Comprises a suite of integrated programs to produce all delivery notes, sales invoices and customers statements for a food distributor handling up to 1000 different products, up to 1000 customers and up to 100 company distribution locations. Controls orders-in-hand, delivery route scheduling, sales ledger and credit control as well as giving comprehensive stock control and price lists. Management reports include sales and stock analyses and other information. From about £12000. Runs on Data General hardware. *BB (FOOD DISTRIBUTORS)*

SPACE-TIME SYSTEMS LTD
SPACE TIME SYSTEMS LTD BOCS Box Office Computer System. Pre programmed for each individual theatre and every performance so that it always offers 'the best available seat in the house'. Box office routines include analysis by seat price of gross receipts, total sold, not sold and percentage sold. Can provide full marketing reports on sales trends, response to particular promotions, advance sales progress and automatic invoicing of agencies by the theatre

Developed for DEC PDP 11/34 /23 and /44 models *MB (THEATRES)*



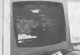
Data General compatible screen handling is an important feature of the new Microsoft Version 4 0 Cobol-80 launched in Europe by Vector Microsoft

SYSTEMATICS INTERNATIONAL
SYSTEMATICS INTERNATIONAL Financial Controller complete suite of Pascal based accounting systems for Apple III microcomputer Offers general ledger sales ledger purchase ledger and financial planning £1000 *SB (APPLE)*

TEKTRONIX
TEKTRONIX extended version of Pascal language based on ISO draft standard Compiler enhanced with chip level input/output (I/O) interrupt handling and linkage to assembly language Supports Intel 8080 and 8085 microprocessors *MB (PASCAL*

U-MICROCOMPUTERS
U-MICROCOMPUTERS STRATEGIC SIMULATIONS INC WARGAMES for Apple II Computer Bismark Computer Napoleonics and Computer Ambush Require 48K Apple II with Applesoft in ROM and single disk drive £29 95 *PU (APPLE)*

VECTOR MICROSOFT
VECTOR MICROSOFT COBOL-80 Version 4 0 incorporates major interactive features Data General compatible ACCEPT and DISPLAY verbs Screen section for the definition of formatted screens Special syntax for cursor positioning protected and unprotected fields highlighting full and partial screen erases and for defining connections between fields defined on the screen and data source destination fields in working storage CHAIN allows any number of separately coded applications or application segments to be reached from a controlling COBOL program *MB OEM (COBOL)*



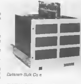
Seat plans showing the sold unsold reserved status of seats displayed on the video terminal

BRAND NEWS

Disks, Tapes, Punches, Readers

BURROUGHS
BURROUGHS FD 210 Series of 14" Winchester technology fixed disk drives FD 211 has 20 MB FD214 80 MB capacity Interface compatible with MD 122 6 megabyte dual floppy drive Built in microprocessor controller performs many of the tasks normally required of the host system file search confidence/diagnostic tests CRC generation error detection/correction and sector relocation Simple parallel interface and command set enables fast system integration Drive module comprises sealed unit containing one or four disks mounted on common spindle Average access time 35ns transfer rate over 7 million bits/sec *MB BS*

DATARAM
DATARAM BC–205 Bulk Core system Industry's only disk emulation system for DEC PDP 15 series Compatible with DEC RF15/RS09 Fixed Head Disk System Software compatible with standard operating systems and RF 15 diagnostics used on PDP–15 Minimum configuration is 248K by 18 which can be expanded in increments of 258K by adding additional Bulk Core Modules Incorporates write protect capability and built in off line tester Available from Sintrom *MB(DEC PDP 15)*



Dataram Bulk Core

DIGITAL DATA ELECTRONICS
DIGITAL DATA ELECTRONICS 10 megabyte Winchester technology sealed hard disk drive Together with 1 megabyte 8" floppy drive for security copying provides a powerful reliable background for a medium sized educational or business user £3595 plus VAT with controller cabinet and power supply *MB(SPC/1)*

DIGITAL EQUIPMENT CORP (DEC)
DIGITAL EQUIPMENT CORP (DEC) RP20 high density 1 2 gigabyte disk storage unit for use with DEC system 10 and 20 families of mainframe computers Comprises RP20 disk unit and controller Up to 3 additional RP20 disk units can be attached to the RPT20 making it the highest capacity mass storage system offered by DEC Each disk storage unit consists of 2 data modules each providing more than 496 MB of formatted disk storage Each data module has 15 recording surfaces with 2 read/write heads per surface and a transfer rate of 1 2 MB per second Dual port option enables each data module to transfer data independently *BB(DECSYSTEM 10/20)*

EXTEL
EXTEL RP50 fully buffered intelligent reader punch unit with 2 port serial interface Handles 5 or 8 level tape local or remote full or half duplex 4 speeds (960 120 30 and 10) Each port has a 256 character store so that unit can operate at different speeds on either port Reader step circuit fitted on line port for compatibility with DEC equipment Punch speed 50 c p s reader speed 150 c p s *MB*

Extel RP50

KODE
KODE market ALLOY ENGINEERING INC s range of ¼" Cartridge Magnetic Tape Subsystems in U K and Eire Range incorporates DATA ELECTRONICS INC s 6400 B P I Cartridge Magnetic Tape Transport as well as controllers and power supplies Controllers available include S100 bus Intel Multibus and Data General microNOVA compatible plug in boards Other controllers either emulate PERTEC FT8000 ½" reel-to reel magnetic tape transport or permit connection via standard asynchronous RS232 port Major application for controllers is as a back up device for 8" Winchester technology type disk drives Up to 14 5 MB of formatted data can be stored on a single 450 ft ¼" tape cartridge at transfer rates of up to 50000 bytes per sec May also be used for input/output *MB OEM*

MATOR
MATOR CHICHESTER comprehensive controller and file handling system for Winchester technology disks Typically gives over 27 MB of formatted online storage from a basic 30 MB unformatted disk Also handles automatic sector interleaving Capable of operating as a non intelligent controller at the level of reading and writing absolute sectors Main strength of Chichester is its capability to access the disk via its inbuilt file handling facilities Up to 1358 files can be allocated on each disk and up to 16 may be assigned to the user at any one time A file may be from 1 to 108030 sectors in length Commands are available to read or write sequentially to a file using fixed or variable length records or to perform such operations as file allocation deletion while protecting copying and renaming Further command enables disk to be compacted by removing gaps *MB (Winchester)*

MFE LTD
MFE LTD four new models in range of digital tape transports featuring drop in cassette loading system Double-track models 450C and 425C single track 250C and 250CH Share the same performance features as the company s Models 250B 250BH 450B and 452B which use an alternative cassette retention system Philips

The Model 450C cassette drive a new product from MFE

compatible meet ECMA/AMSII standards MBTF rating 15000 hours Single track models hold up to 360000 bytes double track 720000 bytes *MB*

MIDLECTRON

MIDLECTRON TELEX MATE Telex Tape Preparation Unit Intelligent paper tape reader punch unit Converts 5 level to 8 level and vice versa Connected to VDU or word processor is ideal off line telex tape preparation unit allowing tapes to be prepared edited and checked whilst leaving the telex free for incoming messages Operates from 50 to 9600 Baud reads up to 150 cps and punches up to 50 cps 4K buffer on punch Operates in full or half duplex mode and responds to incoming remote control characters (DC1 to DC4) RS [illegible] mA interfaces *MB(TELEX)*

TELEX MATE Telex tape preparation unit from Midlectron Ltd

RACK DATA

RACK DATA have been appointed distributors [illegible] PRIAM's range of Winchester technology disk drives The Priam [illegible] range file capacities of 21 to 158 megabytes *MB BB OEM*

TELEPRINTER EQUIPMENT

TELEPRINTER EQUIPMENT SRP 750 powerful microprocessor based paper tape reader/punch combo Buffered input permits communication baud rates up to 2400 improving throughput productivity 4 times that of previous models Dual RS232 ports allow unit to be configured in either terminal or peripheral mode Max punch speed 75 characters per second Preprogrammed self diagnostic tests *MB*

TREND

TREND RPT 18 Paper Tape Reader Punch Microprocessor controlled table top unit designed for quiet reliable and flexible operation Incorporates Trend DLC reader/punch mechanism which operates at speeds of up to 30 characters per second Available with ASCII to NC or ASCII to BAUDOT code conversion capabilities Standard features include terminal response to remotely generated or locally read codes plus search code functions for tape editing Optional features include Current Loop Interface Answerback and 4K to 12K internal buffer store Applications include off line telex tape preparation generation and editing of numerical control machine tool tapes and use for code conversion without punching tape *MB*

Trend's Paper Tape Reader Punch Terminal RPT 18

X-DATA

X DATA REMEX 20/40 slimline dual drive subsystem with own power supply and either 2 single-head RFD 2000/2001 (single/double density) drives or 2 dual-headed RFD 4000/4001 (single/double density) drives Rack mountable Media compatible with single sided IBM 33FD and 2-sided (single and double density) IBM 43FD drives *MB OEM*

XITAN SYSTEMS

XITAN SYSTEMS first hard disk backup available in the UK for Cromemco Z 2H Winchester drive users of CP/M and CDOS S100 systems Package includes cartridge drive power supply cables S100 interface card and software and an optional case enclosure Provides 13.4 MB of formatted data storage at 6400 B.P.I. in 4 track serial recording mode Speed is 30 ips read write and 90 ips bi-directional search and rewind Data transfer 192000 bits per second Features DC3000 XL cartridge with a DEI drive Hardware compatible with Z80A S100 micro system record size is software controlled and firmware takes 1K Facilities include Boot Backspace Clear Erase Initialise Read Rewind Search Select Space and Status Software features include Save Restore Rewind Directory Find Use Logon Logoff Printon Printoff Compare Newset Oldset Endset and Exit £1850 plus VAT *MB (CROMEMCO)*

Teleprinter Equipment Ltd's new SRP 750

VDUs, Graphics, Terminals & Systems

ANSAFONE

ANSAFONE subsidiary VIEWDATA BUSINESS SYSTEMS market range of visual information (Prestel) terminals first of which is new VISA terminal from Pye TMC Ltd VISA allows access to the Post Office's 165 000 pages of information plus with database approval private viewdata databases 2 way capability allows user to eg order goods or further information £750 excluding Post Office's operating and connection charges *MB (Prestel)*

AYDIN CONTROLS/VECTOR-UK

AYDIN CONTROLS/VECTOR UK HVG 001 Hardware Vector Generator for 5216 colour graphics display computer Used in conjunction with Aydin graphics firmware package to draw any two-dimensional vector given the vector end points Provides speed advantage of between 15 and 50 times Additional functions include textured vectors word to screen coordinate transformation rotation translation scaling window clipping viewport clipping filled triangle generation and high speed screen clearing Basic drawing rate of generator is 800ns per pixel (picture dot) and set up time varies In addition Model 5518 Data Exerciser simulates computer input and output for offline testing of 5205 5215 and 5217 display generators eliminating the need to tie up expensive computer time for testing purposes *MB BB*

The Aydin Model 5518 Data Exerciser

CALCOMP

CALCOMP has announced two additional output options for use with Model 31 Colour Graphics System 16mm movie film and Polaroid SX 70 instant prints *MB BB*

CIFER

CIFER 2600 Range of microprocessor based terminals now feature emulators for the DEC VT52 and Data General 6053 VDUs All 2600 terminals are of compact design and have detached keyboards high definition characters anti-glare screens and have a printer port fitted as standard *MB (DEC Data General)*

DATATYPE TERMINALS

DATATYPE TERMINALS DT2 and DT22 microprocessor controlled video display terminals with optional graphics provide a comprehensively featured alpha capability while the graphics option on each gives 512

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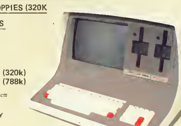

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Why the Sinclair ZX80 is Britain's best selling

Built: £99.95

Including VAT post and packing free course in computing free mains adaptor

Kit: £79.95

Including VAT post and packing free course in computing

This is the ZX80 A really powerful full-facility computer matching or surpassing other personal computers at several times the price Personal Computer World gave it 5 stars for excellent value Benchmark tests say it s faster than all previous personal computers

Programmed in BASIC – the world's most popular language – the ZX80 is suitable for beginners and experts alike And response from enthusiasts has been tremendous – over 20 000 ZX80s have been sold so far!

Powerful ROM and BASIC interpreter

The 4K BASIC ROM offers remarkable programming advantages

* Unique one touch' key word entry the ZX80 eliminates a great deal of tiresome typing Key words (RUN PRINT LIST etc) have their own single key entry
* Unique syntax check A cursor identifies errors immediately
* Excellent string-handling capability – takes up to 26 string variables of any length All strings can undergo all relational tests (e g comparison)
* Up to 26 single dimension arrays
* FOR/NEXT loops nested up to 26.
* Variable names of any length.
* BASIC language also handles full Boolean arithmetic conditional expressions etc
* Randomise function useful for games and secret codes as well as more serious applications
* Timer under program control
* PEEK and POKE enable entry of machine code instructions.
* High-resolution graphics
* Lines of unlimited length

Unique RAM

The ZX80 s 1K-BYTE RAM is the equivalent of up to 4K BYTES in a conventional computer – typically storing 100 lines of BASIC

No other personal computer offers this unique combination of high capability and low price

The ZX80 as a family learning aid Children of 10 years and upwards are quick to understand the principles of computing – and enjoy their personal computer

The Sinclair teach-yourself BASIC manual

If the specifications of the Sinclair ZX80 mean little to you – don t worry They re all explained in the specially written 128-page book (free with every ZX80) The book makes learning easy exciting and enjoyable and represents a complete course in BASIC programming – from first principles to complex programs

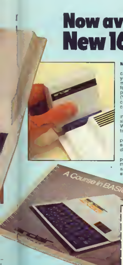
Kit or built – it's up to you

In kit form the ZX80 is pleasantly easy to assemble using a fine-tipped soldering iron And you may already have a suitable mains adaptor – 600 mA at 9V DC nominal unregulated If not see the coupon

Both kit and built versions come complete with all necessary leads to connect to your TV (colour or black and white) and cassette recorder Plug in and you re ready to go (Built versions come with mains adaptor)

personal computer.

Now available for the ZX80...
New 16K-BYTE RAM pack



Massive add-on memory Only £49 95
The new 16K BYTE RAM pack is a complete module designed to provide you–and your Sinclair ZX80–with massive add on memory You can use it for those really long and complex programs–or as a personal database (Yet it can cost as little as half the price of competitive add-on memory for other computers)

For example you could write an interactive or conversational program to show people what your ZX80 can do With 16K BYTES of RAM they could be talking to your computer for hours!

Or you can store a mass of data–perhaps in a fairly simple program–such as a name and address list or a telephone directory

And by linking a number of separate programs together into one giant but modular program you can achieve the same effect as loading several programs at once

We're also confident that it won t be long before you can buy cassette based software using the full 16K-BYTE RAM So keep an eye on the personal computer magazines–and brush up your chess perhaps!

The RAM pack simply plugs into the existing expansion port on the rear of the ZX80 No wires no soldering It's a matter of seconds and you don t need another power supply You can only add one RAM pack to your ZX80–but with 16K BYTES who could want more!

How to order
Demand for the ZX80 exceeds all other personal computers put together! So use the coupon to order today for the earliest possible delivery All orders will be despatched in strict rotation We ll acknowledge each order by return and tell you exactly when your ZX80 will be delivered If you choose not to wait you can cancel your order immediately and your money will be refunded at once Again of course you may return your ZX80 as received within 14 days for a full refund We want you to be satisfied beyond all doubt–and we have no doubt that you will be

To Science of Cambridge FREEPOST 7 Cambridge CB2 1YY
Remember all prices shown include VAT postage and packing No hidden extras Please send me

Qty	Item	Code	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s) Price includes ZX80 BASIC manual excludes mains adaptor	02	79.95	
	Ready assembled Sinclair ZX80 Personal Computer(s) Price includes ZX80 BASIC manual and mains adaptor	01	99.95	
	Mains Adaptor(s) (600mA at 9V DC nominal unregulated)	03	8.95	
	16K-BYTE RAM pack(s)	16	49.95	
	Sinclair ZX80 Manual(s) (Free manual with every ZX80 kit or ready made computer)	06	5.00	

NB Your Sinclair ZX80 may qualify as a business expense **TOTAL** £

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We are now entering our fourth financial year of dealing solely in the personal computer market – in fact, we started it! Over this period, Personal Computers Limited have formed a group of graduate specialists who will help you in the fields of word processing, financial planning, statistics, economic modelling, forecasting accounting systems, foreign exchange, banking and oil exploration.

We also do rather well with computer graphics and highly recommend the graphics tablets and our plotter for Apple

We can also offer two excellent items of software – Format 40 and Visicalc – at a combined price of ONLY £189, and the [illegible] Sound Generator for only £90! (excl. V.A.T.)

8" Disk Drive *(above left)*
Our 8" disks are still as popular as [illegible] the reliable security of Shugart [illegible] uses the same O.O.S.

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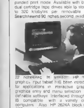
BRAND NEWs

ry 250 dot matrix plotting resolution programmable controls and Tektronix 4010 compatibility 12 by 10 character resolution in alpha mode on 24 line by 80 character display 96 ASCII characters displayable Full QWERTY keyboard with additional 14 key numeric pad DT22 has further 11 special function keys and 6 keys providing editing functions Addressable cursor RS 232C and 20mA current loop interfaces with transmission rates switch selectable between 75 and 9600 b p s full/half duplex 10 or 11 bit word From £1300 *MB*

ELBIT DATA SYSTEMS LTD
ELBIT DATA SYSTEMS LTD DS2000 (APL) upgraded version of DS 2000 (A) to give full switch selectable extended APL character set including all over strike facilities Microprocessor controlled Full editing six high light modes line insert and delete two pages of memory 96 character set. In addition a new word processing keyboard engraved with WordStar functions is available for use with DS 1920 and DS 2000 (A) VDUs *MB (APL, Wordstar)*

HARRIS
HARRIS 1685 microprocessor controlled display terminal for use with Harris 1600 line of distributed data processing systems Compatible with 1675 keystation and offers 15" screen and standard 1920 character display Baud rates up to 4800 May be connected to 1600 direct by up to 1000 feet of cable or over private or P O telephone lines *BB*

HEWLETT-PACKARD
HEWLETT PACKARD HP 2675A portable terminal Features high-speed thermal printing and optional integrated mass storage "First terminal in its class to offer selectable columns per line and enhanced characters on a quiet thermal printer Also has 8 user definable softkeys 120 c p s 7 by 11 dot matrix 132 columns on 8½" paper expanded print mode Available with built in dual cartridge tape drives able to store up to 320 kilobytes per removable tape Search/rewind 90 inches second read/write



22 inches/sec In addition HP 9111A graphics input tablet has been introduced for applications in interactive graphics graphics entry and menu selection User definable softkeys Interfaced through HP IB compatible with a variety of HP computers Also HP 2624A block mode CRT terminal It fits a gap between the character mode HP 2621A and the multi screen multi connection HP 2626A." Advanced editing features Standard memory stores 4 pages of 80 character lines 5 additional pages optional optional built in thermal printer external serial printer port standard Inverse video half bright underline blink and non-display screen enhancements standard *MB BB*

ITS
ITS market RAMTEK terminals First is RAMTEK 8215 offered with Uniscope user in mind Plug compatible replacement for U100/U200 terminals 14 by 9 character matrix 8 video field attributes and 10 function keys RID/SID/DID programmable from the keyboard Line insert and delete keys synchronous or non synchronous communication selectable from keyboard RS 232C printer interface *MB BB*

The RAMTEK 8215 UNISCOPE Emulating terminal

KEEN COMPUTERS LTD
KEEN COMPUTERS LTD market ANN ARBOR terminals including AMBASSADOR User definable terminal designed to provide maximum flexibility in an off the-shelf product Implements a major portion of the ANSI X3 64–1979 standard Features 15" screen 12 programmable function keys 30/60 line display versatile setup controls 5 graphic renditions selectable cursor display data line monitor code user selectable page window and status areas full print and copy functions keyboard selectable baud rates 110–19200 XON/XOFF pause control and 94 key detachable keyboard *MB*

KIRBY-LESTER ELECTRONICS
KIRBY LESTER ELECTRONICS Prestel Colour Business Terminals and Peripherals Two way communication via integral alphanumeric keyboard V24 interface for connection to most computer systems and use as a VDU Can be used as a VDU or Prestel terminal as well as being a TV and Teletext receiver From £1595 plus VAT *MB (Prestel)*

LEAR SIEGLER
LEAR SIEGLER range of VDUs and matrix printers including Dumb Terminal with recent enhancements ADM 3A+ microprocessor based IT terminal with full editing facilities ADM-42 Smart Terminal and 310 ballistic printer *SB MB OEM*

MICROSENSE
MICROSENSE TEKSIM ROM based device enables Apple II to emulate a Tektronix 4010 Series Graphics Terminal Employs distributed processing in its programming approach and uses Apple's high-resolution graphics No modifications to host resident program necessary £280 *PU SB (Apple)*

NCR
NCR new range of intelligent terminals which can be used as stand alone data entry systems media conversion devices and programmable desk top computers designated 7500 series Three models

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Decwriter II LA36 60cps	£ 876
Elbit DS 1920 VDU	£ 652
Televideo TV1 912 VDU	£ 476

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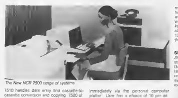
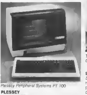


The New NCR 7500 range of systems

7510 handles data entry and cassette-to-cassette conversion and copying 7520 offers floppy disk data entry and conversion from floppy disk to floppy disk or magnetic tape and 7530 provides data entry to cassette tapes or floppy disks and conversion between cassette tapes floppy disks and magnetic tapes Can communicate with each other and with NCR Century and 8000 Series computers through optional binary synchronous communications adaptor Support IBM 2780/3780 protocols Basic memory 48 KB BASIC+6 occupies approx 22K Options include matrix printer From £2800 Also introduced is a general purpose microprocessor based terminal NCR 2950 which can be programmed by the user to handle a variety of information processing tasks and which provides extensive cash control auditing and security features Can be used free-standing or on line to host computer Comprises 12" screen and 105 keyboard including separate numeric pad *SB MB BB*

PERSONAL COMPUTERS LTD

PERSONAL COMPUTERS LTD PPS Pad To Plotter System comprises an Apple II 48K microcomputer video screen disk packs graphics tablet and A3 personal computer plotter Software enables user to draw onto the graphics tablet a design which can either be dumped into the system and altered via the screen or reproduced immediately via the personal computer plotter User has a choice of 16 pre defined shapes and further selection of at least 5 user definable shapes that can be stored by the system Within moments of the design being input to the graphics tablet a drawing accurate to 1/10 mm will be produced on the plotter From £3250 *PU SB*



Plessey Peripheral Systems PT 100

PLESSEY

PLESSEY PT-100 video display terminal compatible with DEC VT 100 Features include full advanced video package screen capacity of up to 132 columns by 24 lines bold and half bright characters 20mA current loop interface or RS232 interface for modem operation and a printer port Screen has split screen and pictorial capability and smooth scrolling Double height double width characters 18 key numeric/function keypad keyboard and/or computer selectable tab stops built in test diagnostics and 15 baud rates up to 19200 selectable from the keyboard From £1263 *MB (DEC)*

SIGMA

SIGMA new terminal T5470 sets new world standards in high resolution Raster Graphics with 1536 by 1024 matrix Emulates Tektronix 4014 and T5680 768 by 512 resolution colour graphic terminal Also available ARGS (Advanced Raster Graphics System) *MB BB*

The Sigma Electronic's new T5470 Raster Graphics terminal

SPERRY-UNIVAC

SPERRY UNIVAC UTS 4000 family of communications terminals Comprises microprocessor based teletype compatible display terminals UTS 10 teletype compatible display UTS editing facility and UTS 40 user programmable VDU Feature Hi-ro tate base non glare screen display intensity control and palm rest Also UTS 20 Cluster Controller *BB*

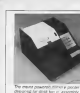
SWEDA

SWEDA L50 Series of Electronic Cash Registers provide most of the benefits of an advanced point of sale system without the need for a back-office computer Can be installed as a stand alone electronic cash register or as a full POS system providing consolidated trading and financial reporting data collection and telecommunications Three models in range L55–10/20/30 with 18 fixed and 22/34 84 programmable keys respectively and increasing internal memory All models have the ability to form an integrated system using up to 31 registers controlled by a managers terminal *MB BB (P O S)*

TANDBERG

TANDBERG TDV 2200 visual display terminal focuses on human engineering Contrast between background and characters kept constant independent of light intensity adjustment 15" diagonal screen with bonded anti-reflex faceplate Silent op

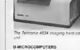
Personal Computers PPS System



The mains powered [illegible] printer is designed for desk top or assembly line operation

eration Displays 256 different characters Adjustable height tilt and swivel *MB*

TEKTRONIX
TEKTRONIX 4634 imaging hard-copy unit produces high quality continuous tone copies from raster scan video sources in seconds Designed for digital image processing pattern recognition remote sensing video communication and high resolution display environments Photographic quality Records on dry silver paper using fibre-optic cathode ray tube with no toners or developers 12 level broad grey scale range Front paper load exit and front panel controls *MB BB*



The Tektronix 4634 imaging hard-copy unit

U-MICROCOMPUTERS
U MICROCOMPUTERS 3G Light Pen for Apple II Utilises Apple game I/O socket Single PEEK in BASIC detects presence of light £34 plus VAT complete with instructions and sample program on cassette *PU (Apple)*

Part of the range of Verbatim Magnetic Data Storage Products from BFI Electronics Ltd

BRAND NEWs

UCSL MICROSYSTEMS
UCSL MICROSYSTEMS M50 ALPHA hand-held terminal offers the simple entry of alphanumeric data Designed to hold custom programmed applications and for two way communication In addition three new printers have been announced desk-top console attache case and van mounted First is mains powered others battery *MB*

X-DATA
X DATA now market TEC range of VDUs Series 510 610 570/670 user oriented displays and top-of the-range Model 70 *MB OEM*

Bureaux, Consultancies, Services, Shops

BFI ELECTRONICS LTD
BFI ELECTRONICS LTD complete range of Verbatim products including floppy disks data cartridges and cassettes *SB MB BB*

DATA EFFICIENCY LTD
DATA EFFICIENCY LTD Mobern Housings Manufactured from sheet steel and bolted for strength Three sizes from around £300 *BB*

D N COMPUTER SERVICES LTD.
D N COMPUTER SERVICES LTD new Floppy Disk Head Cleaners for both 5¼" and 8" sizes Put on drive in same way as normal floppy disk *SB MB*

GORDON AND GOTCH
GORDON AND GOTCH Computerised Share Portfolio Valuation and Management Service Employs data entered by brokers who use online service for daily processing of share transactions Computers revalue all stored portfolios continually for issue on demand Valuations can be produced for stockbroker financial or investment institution within 24 hours Draws on database of 35000 items *BB(FINANCIAL)*

INMAC
INMAC (International Minicomputer Accessories Corporation) largest independent mini and micro computer accessory distributor in the world has opened a service for UK and Europe in Cheshire Range of 500 mini and micro computer accessories varying from disk files to VDU extension cable available on 24 hour dispatch *SB MB BB*

Fixotape Cassette Accessory from Jorephani Exports

JOREPHANI EXPORTS
JOREPHANI EXPORTS FIXOTAPE CASSETTE ACCESSORY an answer to the perennial problem of tangled tapes Cassette is pushed into accessory tape fed through a guide and at the turn of a handle any tangled twisted creased or knotted tape is freed *SB MB*

LEXITYPE
LEXITYPE Media Conversion and Storage Service for Word Processing System users Specialist equipment includes recently acquired buffered data cartridge system Columbia Data Products 300C *MB(WORD PROCESSING)*

MUSE
MUSE (Mini & Micro Computer Users in Secondary Education) NATIONAL INFORMATION AND ADVICE CENTRE for teachers using small computers in schools Located in Birmingham manned by full time experienced teacher with support research and secretarial staff *SB(EDUCATIONAL)*

NEWBEAR COMPUTING STORE LTD
NEWBEAR COMPUTING STORE LTD new protective DUST COVER for Sharp MZ80K Made of heavy duty cloth backed vinyl £9.95 *PU SB(MZ80K)*

PHOTO-SCAN LTD
PHOTO SCAN LTD Personal Pass System Passive XS passes are individually detected at a distance of 70cm from access door to eg computer room Several levels of access authority offered also time zoning *MB BB (SECURITY)*

POWER EQUIPMENT CO LTD
POWER EQUIPMENT CO LTD new range of Printer Stands for word and data processing printers Housed in Powquip noise absorbing acoustic enclosures Fabricated in rigid square section steel tube with matt black paint finish *MB BB*

Power Equipment's new range of stands suitable for all types of printer

SCICON
SCICON bureau service for organisations with large bulk purchasing requirements Buying models can be applied to the purchasing problems giving an average of 10 1 cost saving against normal cost of running the model The computer techniques which require no computer expertise on behalf of the purchaser enable all of the purchasing factors to be rapidly evaluated to produce the best optimum solution at the

least cost and yet within all the constraints imposed *MB BB (BUYING)*

VICKERS FURNITURE
VICKERS FURNITURE new office desking system System E designed for the electronic office of the 80s Comprises 5 basic modules incorporating segregated wireways within the framework of each desk These connect with inset and covered wiring channels located at rear of desk Desk tops have hinged covers for access to electrical or telecommunications output sockets Links with associated screening and storage products *MB BB (ELECTRONIC OFFICE)*

WILLIS COMPUTER SUPPLIES
WILLIS COMPUTER SUPPLIES range of read/write head cleaning disks for 8 and 5¼ inch single and double sided drives Claim that the technology enables wear to be kept within industry standards for normal magnetic media (less than 25 microinches after 92 hours of continuous work) *SB MB*

Exhibitions, Courses, Events

BATALAS LTD
BATALAS LTD One week training course designed to help participants to improve the profitability of their organisations by increasing the value and competitiveness of their products and services Next dates 13–16 April 1981 12–16 October 1981 in Guildford *MANAGERS*

BRAND NEWs

BIS APPLIED SYSTEMS LTD
BIS APPLIED SYSTEMS LTD course PROGRAM DESIGN TECHNIQUES Intended for programmers with 6–12 months experience Object of course is to extend less experienced programmers knowledge of methods techniques documentation and team activities in a structured programming environment 3 days £275 non residential Next date 6–8 January 1981 *PROGRAMMERS (6–12 months)*

BUSINESS EQUIPMENT TRADE ASSOCIATION
BUSINESS EQUIPMENT TRADE ASSOCIATION forthcoming events Business Equipment Trade Fair London 1–3 March Scottish Business Show Glasgow 16–20 March Nottingham Business Efficiency Exhibition Nottingham 28–30 April Newcastle Business Efficiency Exhibition Newcastle 19–21 May Southampton Business Efficiency Exhibition Southampton 16–16 June International Word Processing Exhibition and conference Wembley 23–26 June International Business Show Birmingham 20–29 October IBETA Business Equipment Exhibition Cork, 10–12 November *SB MB BB*

CAMBRIDGE MICRO COMPUTERS LTD
CAMBRIDGE MICRO COMPUTERS LTD courses for 1981 Introduction to the Design of Microprocessor Systems Design of Industrial Microprocessor Systems Z80000 Workshop Programming in Pascal Advanced Systems Design Structured Programming in BASIC Offered at various dates during Jan Jan 81 *ENGINEERS PROGRAMMERS*

COMMUNICATIONS 82
COMMUNICATIONS 82 20–23 April 1982 National Exhibition Centre Birmingham sixth in series of biennial international expositions dealing with communications equipment and systems Will comprise major international exhibition integral international conference and full programme of social events with guest speakers Organised by Tony Davies Communications *SB MB BB (COMMUNICATIONS)*

CRANFIELD SCHOOL OF MANAGEMENT
CRANFIELD SCHOOL OF MANAGEMENT leading international postgraduate business school offers highest level of relevant training in management Programmes include Master of Business Administration (MBA) 12 month course geared to the development of those managerial skills necessary for the potential senior manager Research (Ph D) aiming to combine the rigour of academic research with a close study of the real problems of organisations and Continuing Studies shorter programmes for practising managers designed to fit in with constant practical on the job learning Public programmes fall into 3 main sections general management programmes Manage

Computers: thinking small?

Cranfield School of Management is offering two new programmes in making the most effective use of recent advances in computer technology Both programmes are geared to the needs of managers who are not computer specialists but who wish to learn how small computers can contribute to the successful running of their business

The Minicomputer Solution (2 days) aims to help senior managers from organisations of any size assess the information processing needs of their organisation (or function) and evaluate the potential usefulness of minicomputers and small business computers in this context The programme also aids participants in managing the introduction of a minicomputer into their businesses and in planning the day to-day operation of the computer once it has been installed

Although the School of Management s own minicomputer is used for illustrative purposes the programme material is designed to be independent of any particular supplier

Using Personal Computers in Management (2½ days) shows how micro-computers and also bureaux can be used as an aid to management decision making with applications in planning forecasting and analysis Practical exercises involving managerial applications ensure that participants have a thorough grounding in the basic principles and concepts underlying the use of these management aids Participants will become familiar with the role of personal computing in business including micro-computers and time sharing bureaux, and will be able to assess their relevance to the needs of their own organisations

The course is primarily designed for managers who wish to use computers in the course of their work as managers

We shall be happy to send you further details on these programmes as soon as we receive your completed coupon or telephone call

To The Course Tutor or Administrative Officer
Minicomputer Solution/Using Personal Computers in Management
Cranfield School of Management, Cranfield, Bedford MK43 0AL
Tel (0234) 751122. Telex 825072

Please send me further details of the **Minicomputer Solution/Using Personal Computers in Management** programme so that I and my company may judge its relevance to us

Cranfield
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The Logic of Imagination

BASF the giant German company recently brought out a magnificent table-top calendar and posters that are sure to become collector's items

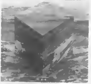
The father of logic is Aristotle But for him Leibniz might not have discovered the logic of the binary system the logic which now 300 years later forms the basis of our computer technology in which zero and one contrast like non-existence and existence, darkness and light no and yes false and true The science of technics is logical

The illogical is mathematically proved impossible absurd But there are no bounds to imagination

Real – unreal formula fixed – random are these equivalents of logic here and illogic there? Why shouldn t fish fly and eggs have feathers? The logic of imagination makes the illogical appear real

● *From a BASF publication designed by Rambow Lienemeyer van de Sand 80*

Nature takes the course of least [illegible].
The contours of free-flowing [illegible] streamlined
Freeze the motion of living things and behold –
a monument.



Nature s many forms in motion
The tides and the seasons make it [illegible]
The cube represents knowledge
describing, confining and marking [illegible]
Exact dimensions are formed.
Only to be dissolved by nature.

The primeval form of life.
Equipped with biography of birth A bird to be.
Why not follow the logic?
The development is anticipated and transferred to the beginning light as a feather

The earth [illegible]
A sphere with a [illegible] en
or an ocean
We re on this [illegible]
on mol plant and ma
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W[illegible]

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ON 'OF'

The naming of names

It is said that when Cook (or whoever it was) discovered Australia (or wherever it was), one of the first animals his men encountered was a bounding bouncing creature unlike anything they'd seen before. They kept asking the natives what it was.

'Kangaroo', the natives replied. Thus our name for the beast. Unfortunately, 'Kangaroo' was simply the local inhabitants' way of saying 'pardon?' or 'I don't understand.'

This unoriginal story may serve as a keynote for this month's piece: at least it serves to remind us that the arbitrary isomorphisms we employ owe as much to gaffes and general hegemony and nonsense as anything else.

The same thing can be referred to by different names. As when one person calls a colour, whose frequency is near the slow end of the visible spectrum 'red', and another person names it as 'orange'. ("I have transmitted (light) through coloured mediums and diversely terminated it, and yet could never produce a new colour out of it', said Newton, yet, verbally, we do.)

Above is a picture, or rather a group of pictures. They are all 'of' my Research Machines 380Z computer, its keyboard, tv monitor and cassette recorder. They are presented in 'sketch mode', i.e. the lines don't necessarily join up: it's all a bit, you know, freehand and arty (though produced on a Calcomp plotter).

You can see that one image is more or less 'normal', and that two are greatly distorted (being rotated in three dimensions, with false perspective). There is also a collapsed version, consisting merely of a series of lines, virtually on top of one another.

They are all 'of' my computer system and someone might say that they represent it, symbolize it or picture it.

However confusing this gets, we may at least assert that they are *not* a score for the computer system, nor a description of it (though this is weaker), in the way that, for example, the symbolic representation of the lines, held inside the computer, is a score or description for the drawing on the plotter.

What does this mean – what, if anything, does it tell us about our ways of making and acting upon representations of the world?

If I encode a picture of Leonardo's 'Madonna with carnation' into a computer system, what exactly is residing in the chips or on the tape or disk?

If I then realise the image once again, but turn it round so that the baby Jesus' hand, originally merely raised across the canvas, now slams out of perspective at the viewer as if trying to cover the camera lens like a cornered criminal politician, or bereaved film star – what have I done? What is it?

And what about representations of 'impossible' objects like Escher staircases, or, verbally, things in 'Alice Through the Looking Glass'? I'm not sure it matters *what* we examine: painting, equation, cash-flow problem or love-letter may be held in a computer in some form, and they are all anyway representations of other things.

But I want to talk about this problem from a more-or-less visual point of view simply because in art (and design) I think it does matter, it is important.

Why? because in art (as, less clearly sometimes but surely still so, in 'life' and stuff) everything is now possible: all is there, the merest gesture with charcoal, flame thrower or pretty laser is on colour slide in the files of the Department of History of Art and Complementary Studies at the Polytechnic of East Cheam.

Thus we are left with qualitative questions, now there is no more science fiction. Not 'how', still less 'how much' – but 'why?' Not even selection, but direction.

We know now that with art or literature or music (or, for God's sake, with general purpose wonder-machines named after the fruit of the garden of Eden) – we know that the thing is not to make 'revolutionary art', 'aware prose' or 'peoples' computer programs', but to *be* revolutionary, or 'aware', or 'people'. (This is very difficult, of course.)

So we need a tool, a cutting edge to hack a way through the jungle that surrounds, yet paradoxically feeds the more sinister roots of, art and (yes) computing.

That tool, I argue (did you know that 'argue' means, literally, 'to make silver'? – thought I'd mention it) is a theory of representation, a way of looking at things that will provide a clear indication of *why* they are, what they are *of*, and thus will enable us to evaluate them and their associated practices and productions.

The alternative is to be blinded by the fact that this painting cost a million pounds, or that computer operates on lithium or love.

In case I'm getting confused here, let's go back to the simple questions. If I cause my computer to contain a symbolic representation of an image, what is going on? Or is that too easy, or too hard? What about if it contains you?

I mean, suppose I hold a representation of you in the computer. It could be ... what? ... a likeness? A picture, or a simulation? A model?

'This painting is like the Mona Lisa.' Ah, but it is not the Mona Lisa. Or it is not *the* Mona Lisa. In fact, it was painted by someone who had never seen the Mona Lisa, nor a reproduction of a copy of it – or should it be her?

'Here is a photograph of a man running down a grassy slope.' No – quite wrong. It is a photo of my mad Uncle

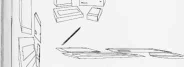
Albert running backwards *up* a hill. The two photographs referred to, though identical, would be *of* quite separate events.

A computer model of the economy is quite clearly *not* the economy itself. Yet we can use it. More specifically, I can use mine, you yours, the Treasury theirs and Albania can operate on yet another and I expect it does.

Computers operate logically upon symbols not numbers. They can represent anything including numbers. You can represent fixed things in computers, or things about which there is doubt. Using Lotfi Zadeh's fuzzy set theory, you can say that X is about .5 of Y. You can talk about fuzzy decisions, and mean the intersection of fuzzy goals and constraints in a given space of alternatives.

It is important to distinguish between randomness and fuzziness. So often we approximate to things we can't yet get to grips with, by a willy-nilly, yes and-no, have-it-both ways 'method' of computing, of representing and of living.

Randomness deals with uncertainty concerning membership or non-membership of an entity in a non-fuzzy set. It may be discussed in terms of probability theory.



Four views of my computer system

(In Sketch Mode)

Fuzziness, however, deals with cases in which there may be grades of membership intermediate between full- and non-membership, and the techniques for dealing with these things are simpler than probability theory.

So – we can use such techniques as fuzzy representations to (time is short – let's say 'model') model something. Certain features of the model will correspond in some well-defined way to certain features of the thing modelled (call it 'X'). Changes in the model similarly correspond to changes in X. One can learn about X from the model.

And then I show it on the screen in colour, turned sideways on, literally or metaphorically. It is photographed; then a Xerox made. This copy is lost, then turns up, wet through, in the gutter. You notice it, dry it out, iron it flat. It looks good, and your husband (who is doing an Open University level 2 course on Art and the Environment) includes it in a collage and mails it to his tutor.

She looks at it, it reminds her of something.

What is it *of*, now? ■

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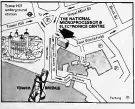

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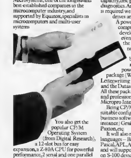

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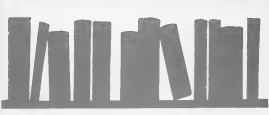
Book Review

Lyn Antill



Cobol Programming – a structured approach

by *Peter Abel* Published by Prentice/Hall International Price £8 40 paperback (500 pp)

Let me start off by declaring my interest in this book – I teach Cobol programming with a distinct bias towards commercial good practice Since Cobol is only normally used for business programming a text book in the subject is of little use unless it teaches not only the language but the way in which it is used in practice

IBM ANS Cobol is used throughout the book This is probably the most popular single implementation of Cobol The author points out that the Environment Division differs from one machine to another but most of what is said will apply to any Cobol implementation Also what is said on Indexed and Relative files may not be the same in every detail These differences do not seriously detract from the value of the explanations in the book as the manufacturer's manuals will make clear the exact Cobol statements to be used However the difference in Job Control statements between one machine and another could prove baffling to the beginner trying to work directly from this book This problem would not arise if the book were being used as a class text because the information about IBM job control is in a separate chapter at the end and could easily be ignored by the non IBM user

The book itself is extremely well printed being properly typeset and not just a photo-reduced computer printout. The headings are clear there are plenty of diagrams and examples and a good table of contents and index The user would have no difficulty in finding what he wanted

I was surprised to see so many flowcharts in a book about *structured* programming as I had expected to see hierarchical structure charts This is the program design method taught by IBM themselves In fact both charting methods are used each in their proper place The author shows a sensible balance between the two adopting a pragmatic approach to matters of program design and documentation He concentrates rather on the way Cobol itself can best be used rather than preaching any particular programming ideology

A brief introduction to computers and to programming leads into an explanation of Cobol concepts the way a program is put together, and the essential Cobol instructions The explanations are good and plenty of examples are given. The author has succeeded in producing that most unusual object – a short Cobol program which he builds on He also demonstrates how to compile it, and how to identify and correct the sorts of mistakes a beginner is likely to make

The section on programming strategy and style is sound and pragmatic Most programming teachers have their own pet methodology but few would argue with the principles that are laid down here

As well as sections on more difficult aspects of Cobol there are discussions of many different jobs that are frequently done in Cobol – table processing, handling different types of file sorts the Report Writer etc which are all very helpful I was disappointed that there was no mention at all of the Codasyl extensions to Cobol for using a database because this is an increasing proportion of Cobol usage Presumably this was omitted because IBM do not support a Codasyl database

On the whole I thought this a very good textbook and will in fact be recommending it to my students even though we do not use IBM It might seem a strange thing to say but a good Cobol text book is quite a rarity! ■

The CP/M Handbook with MP/M by *Rodney Zaks*

Published by Sybex Inc 1980 ISBN 0–89588–048–2 Paperback price £8 95 (400 pp)
Sole UK distributors *The Computer Bookshop*

This is an instruction manual on how to use the CP/M (tm) operating system with which so many micros are currently equipped The author claims that even a complete novice will be able to follow the explanations in the book Sentences like 'To turn on the Cromemco computer press the ON/OFF switch on the back of the box and turn the key in from to ON' abound and while the expert may sneer at such simplicity, perhaps the businessman who has just had his machine delivered will be very grateful

The only pre requisite for a good understanding of the book is that you have a CP/M machine on which to try out the things that are being explained It is a handbook and it is intended that you should have it to hand when you are attempting anything new CP/M and its commands are presented one at a time and each one is explained in some detail It is clear that the author has been at pains to put these explanations across in terms that would be comprehensible to the layman Especially helpful in this respect are the many samples of screen dialogues which show both the CP/M messages and the operator's response Even so the layman I tried it out on thought that a glossary would have been very helpful as he was continually searching round for explanations which were on another page In fact, it took him several pages to find out what CP/M was as no *direct* explanation was given

This book is also intended to serve as a complete manual for the expert programmer, and would certainly do so for anyone who was not put off by the lengthy explanations required to put the same thing across to a novice Although some sections start off by saying that they are primarily for the expert it is very difficult to decide what parts of CP/M a new user might or might not require because the same operating system is used for such a variety of applications Consequently the author has not been able to write a programmed course of instruction If you know *what* you want to do this book will help you find out *how* to do it Alternatively, it will help you to *explore* the possibilities and find out what you *could* do

That the first print run sold out in a matter of days is in part a testimony to the book but it is also a sad reflection on the low standard of documentation of many micro systems Micro users have put up with shoddy inadequate and sometimes even inaccurate documentation from many of the major micro manufacturers Making sense of the documentation has become an activity in itself This might be all right for the hobbyist but to the serious user it is quite unacceptable Indeed it was the shortage of documentation for his own people that started Rodney Zaks writing this handbook

At £8 95 it is a bit expensive for a popular paperback but it is still marginally cheaper than the average manufacturer's manual As it is much better explained than many manuals it gives correspondingly better value for money and I have no doubt it will continue to sell well ■

Lynn Antill is at the South Bank Polytechnic, London

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Up to only a few years ago a manager who showed any interest in what the funny lights on the computer console meant, or actually understood what 'bytes and 'bugs' referred to, was regarded rather quizzically by his colleagues Computers were mysterious pieces of machinery, to be discussed in vague phrases and hushed whispers And no wonder, they were controlled and operated by mathematical wizards who were unable to answer a layman s question in layman terms Also they were huge, very expensive and any company which invested a vast amount of money in such a complicated machine did not want just any manager calculating his overdraft on it In fact before anyone got his/her hands on a computer he or she had to pass an aptitude test to prove that he/she was a natural programmer Thus a chasm developed between the computer initiate and the rest of the world

We should at this juncture point out in fairness to the data processing professon that the early computers of the 50 s and 60 s were not only difficult and complex, but were also highly unreliable and communication with them was by means of a computer language resembling hieroglyphics! These hieroglyphics are commonly known as 'low level' languages It is not surprising that the average manager abandoned computers, due to fright, sometimes referred to as 'computer phobia' By the beginning of the 70 s, however computers were developed with easy-to-use high level languages A 'high level' language is a computer language which uses many English type commands such as PRINT, READ, INPUT etc

At the same time as computer languages became easier so computers themselves became smaller more efficient and very much cheaper By this stage computers were sufficiently inexpensive, and relatively uncomplicated enough to have allowed most managers to take advantage of the enormous benefits that could be derived But by this time 'computer phobia' had its roots buried very deeply and managers just did not want to know about computing – it was delegated to the specialist and the manager s feelings of inadequacy were compounded

It is well known that a business microcomputer can now be bought for a few thousand pounds What is not fully appreciated is that these small business systems can be used and even programmed by managers with little or no computer background to help them solve their own problems Most managers can be taught, or can teach themselves, programming Admittedly there will be those who will have little aptitude for programming and again there will be those who will develop excellent programs But most people including managers will fall within the middle range of the normal bell shaped curve, and will be able to program enough to solve some of their own problems

So for the manager to face the computer age, the first step is to remove the inhibitions caused by 'computer phobia' This is most easily done by allowing the manager to become fairly closely acquainted with a computer It does not matter which computer is used, provided the computer language is high level language One of the best languages is called BASIC (which stands for Beginners Application Symbolic Interpretive Code) because it was especially developed for the layman The initial steps are best taken in groups where small numbers of managers, say three per group, tackle the problems they are presented with as a team There will, of course, be problems of confusion and frustration but with a competent tutor these wrinkles can be ironed out and the experience can be satisfying and even fun These first encounters with a computer should be spread over a period of time This will allow the important detail to be reasonably fully absorbed and reinforced with private study Of course another important element in this process of learning computing is to have the course business problems oriented so that managers can easily relate the computer to business situations

The effect of such training is remarkable, not so much in the immediate skills acquired by the managers, but rather in the change of attitude towards computensation Once 'computer phobia has been conquered the world of computers becomes accessible ■

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The vast process of education and re-education that is going on in hotel classrooms

Learning in Style

With demand for conferences increasing surprisingly quickly despite the current recession, the major venues like Wembley and the National Exhibition Centre often get booked up three, four and sometimes even five years ahead. At the same time the whole conference business has become a good deal more sophisticated than it was in the mid 1970s when managing directors still expected that their presence on the podium was sufficient to command one hundred per cent attention from everyone in the body of the hall. Today – and nowhere is this more noticeable than in the computer industry – presentations need to be ultra sophisticated, not only to keep the attention of audiences but also because the subjects themselves are so complex.

First consider the human element of the audience. Anyone under the age of 30 has almost certainly grown up in a multi media environment. Indeed they will probably have done their homework while listening to records and keeping half an eye on their favourite TV programme.

While the managing director can, no doubt, tell these bright young people all they need to know about the latest developments in computer technology, that's only half the communication game. Their interest has to be aroused and the knowledge given retained. Experience shows that the most effective way is by the M.D. using multi media techniques.

So for the organiser of the conference, usually the hard pressed sales or marketing director – various questions have to be asked from the outset.

- *The Location* What would be most convenient for those attending? Is it purely a local conference, or will staff from abroad be included?
- *The venue* Having decided roughly where one would like to hold the conference, the next stage is to consider the hotels in the area. What facilities do they offer for the conference itself in terms of meeting rooms, theatres, a/v (audio visual) equipment, etc?

  All work and no play makes Jack a dull boy. So what other facilities are available – e.g. swimming pool, evening entertainment, etc? What's the food like? Most important, is the hotel flexible enough to go along with the demands of the conference programme, or will it be the other way around?

Computer companies hold more conferences than most firms for several good reasons: as the computer industry is truly international, it is essential for companies to keep all their top people informed about latest worldwide developments. Indeed, many of the big companies, such as Ventek, have at least two conferences a year for the express purpose of 'keeping executives fully informed.'

Training and up-dating sessions also form an important part of any computer man's life and often these are best held away from the company's premises. Infotech, for example, almost invariably use hotels for their training programmes.

And finally, there is the all important presentation or launch of a new model to the salesmen. In such cases a great deal of complex information and a stream of facts and figures have to be presented with style and excitement. While visits to national trade exhibitions are made to find out what competitors are doing, the well-organised company conference ensures that key domestic personnel are made fully aware of what is happening within the company itself.

For Alan Watson of Ventek, their 3-day main 'user association' conference held every April is the highlight of the year.

'I've been organising this event for some years now, and I reckon I've visited every hotel in the UK capable of holding a conference for between 200 – 300 people,' he explains. 'In our case location is a prime consideration because we have a fair number of people coming from abroad, so we need to look for a place convenient for them as well as for the home-based staff.

[illegible] s Heathrow Hotel Theatre has seating for 260 with a TV console at every seat

His experience shows that the success of a conference is just as much dependent on how a hotel attends to small details as it does to larger matters.

This year, for instance, Ventek's three day conference was held in the conference centre at London's Heathrow Hotel. 'In the past I have invariably had to pull up the hotel staff or management about something, but so far as the Heathrow Hotel is concerned the service and food is probably almost unequalled anywhere in the UK. And it is partly due to the fact that senior hotel management appoints a co-ordinator who is at our 'beck and call' throughout the duration of the conference.'

It is a three-stream conference, he says, with three separate sessions going on at any one time in addition to several key sessions which everyone attends.

All aspects of computer use are covered, starting from the basic one on installation right through to individual applications, while the presentations themselves involve sophisticated use of the Heathrow's a/v equipment with computerised control of several film projectors running at the same time. And although the conference was in no sense a 'jolly', there was time for a formal banquet one evening during which Bob Monkhouse was featured as the guest speaker.

For this type of concentrated dissemination of information, the company found the Heathrow's Video Theatre, with its main screen and individual and close-circuit TV console at each seat, a particular plus.

Jim Oxberry of Infotech is the man responsible for organising his company's computer language and training courses which are attended by both foreign and local personnel. These are extremely comprehensive – they usually start with word processing and work upwards – and involve several manufacturers. Indeed, in some respects it's almost like a mini exhibition. One lecturer, specialising in mini-computers, brings his own equipment and demonstration model. There's even a telephone link-up with the main terminal.

As with Ventek, the needs of Infotech are both sophisticated and specific. Five years ago, most British hotels simply wouldn't have had the facilities to support this type of exercise. Indeed, there aren't all that many now. But the attitudes and the facilities are slowly changing. Today there is a growing number of British hotels, of which the Heathrow is one of the best examples, which are making deliberate efforts to woo computer industry business. ■

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Man The least adaptable

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▶

A DATASAAB visual display unit, part of the Series 16 range easily adapted to the Managers Requirements

How [illegible] an operator will be [illegible] forced [illegible] this?

[illegible]

Eyes & Eyesight

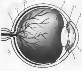
The eye is considered to be the most important sense organ in the human body. Simply described, the eye works like this: Reflected light from an object passes the cornea, the pupil and the lens, and hits the retina at the back of the eye. There the light is converted into electrical impulses which are transmitted to the brain. In other words, you can say that man sees with his brain.

The lens is attached to a muscle which can alter its curvature. So that the eye can adjust its focus for varying distances. This ability to adjust falls off with age. The outer cornea also functions like a lens, but of more fixed nature.

The pupil to some extent regulates the quantity of light, and improves the definition of depth. It contracts when it is exposed to bright light or when the eye looks at objects at close range.

The retina consists of light sensitive cells of two types, rods and cones. The maximum light-sensitivity is in the middle of the retina, diminishing towards the edges. The retina can adjust its capacity to absorb light. Adaption is the technical word for this. Adaption should not take place too rapidly. The eye needs a relatively long adaption time. For this reason dazzling lights and extremes of contrast should be avoided.

[illegible]

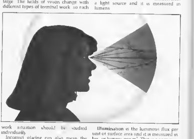


Ergonomics

Limit the eye's field of vision

If the eyes work too intensively and in too large a field of vision the eye muscles become tired. The operator may feel irritated and himself get tired. So the eye's field of vision should be limited. Vertically and horizontally.

For example, this means that a terminal screen should not be too high in relation to the console and papers. The same applies laterally. The distance between the papers and the screen should not be too large. The fields of vision change with different types of terminal work, so each work situation should be studied individually.



Incorrect placing can also mean the neck has to carry loads at awkward angles.

Some points about spectacles

Around the age of 40 the ability of the eye to adapt at short distances falls off. Many people therefore need to start wearing spectacles, and these are normally suitable for reading at 35 cm. Many people wear bifocals (double-ground lenses), which provide normal reading distances of 5 metres and 35 cm.

Glasses such as these are unsuitable for work with computer display terminals as the screen is at a distance about half way between the ideal definition of the spectacles. Operators who wear normal bifocals are forced to adopt positions which are entirely incorrect, with aching neck and shoulders as the result. For other reasons computer operators need to have good eyesight. The text on the screen is often small and not always easy to read.

The best way of preventing eye trouble is to arrange for the operators to have their eyes tested regularly. In Sweden this normally takes place every second year. Diffraction and accommodation difficulties are detected and those who need them can obtain specially tested spectacles. Generally the employer pays for them.

Light & Lighting

Some technical concepts

When you read about light and lighting you will come across several technical concepts:

- brightness, or intensity
- luminous flux
- (intensity of) illumination
- luminance
- reflection factor

Intensity is measured in candles, and it is the basic unit for all other light concepts. The intensity of a stearine candle is approximately equal to one candle.

The luminous flux is the radiation from a light source and it is measured in lumens.

Illumination is the luminous flux per unit of surface area and it is measured in lux, or lumens per m². This is a very useful concept for practical application.

The luminance is the light which reaches the eye from an illuminated or self illuminating surface. It is measured in candles per m².

The reflection factor is a measure of a surface's ability to reflect light. Together with the illumination the reflection factor affects the luminance of a surface. It is usually expressed as a decimal between zero and one, or as a percentage.

Conventional overhead lighting

A computer terminal system is often installed in premises which were previously used for other types of office work. Large windows, light coming from the left of the workplace, white or very light walls, and normal ceiling lighting are most common.

This is by no means suitable for starting to work with terminal screens. The operators see mirror images and reflections from windows and lights, the eye position is often tiring and there is poor contrast on the screens. The light from ceiling lights is often directly dazzling.

Better lighting. A sound investment

Once the decision has been made to install a terminal the premises should be checked over. It doesn't cost a great deal of money to create better lighting conditions.

Curtains and position
Put up curtains or blinds in front of the windows. Position the workstations so the windows are not in the field of vision, or so they do not cause reflections in the table or on the screens.

Darker walls
Cut the capacity of the wall to reflect light by painting them a darker colour than normal with a matt finish. Then the contrast between the walls and the screen will not be so sharp.

Anti-reflection screens
Fit anti-reflection screens on the ceiling lights to eliminate dazzling direct luminous flux. Cut the intensity of the overhead lighting to around 300 lux. This is about half of what is normal.

Adjustable workstation lighting
Then provide each workstation with adjustable lighting. So that each operator can choose the intensity of illumination and direction of illumination to suit his/her own needs. In addition, older people require more light than young ones. A 40-year old needs twice as much as a 20-year old, and a person of 60 needs five or six times as much.

Correct luminance
The eye needs well balanced contrast conditions if it is not to tire. So the luminance of the table surface is important. The luminance ratio between the input data documents and the surrounding table top should be 3:1, which corresponds to white paper on an oak table. The same luminance ratio applies to the table/terminal equipment and the surrounding walls.

When specifying the conditions for a terminal screen, in order to ensure the best conditions for the eyes, the three main demands should be for:

- individual adjustability
- clear text
- free of reflections

Let the individual decide

Regard the terminal screen and the console as highly individual working implements. Each operator should find out for himself what is the best working position so that the text can be read without discomfort.

Symbols

The symbols on the screen are built up on a matrix. At a normal reading distance they should be seen as real letters and digits.

Colour of symbols

The symbols on the screen should be the right colour. The eye's sensitivity to different colours varies. Yellow, with a tendency towards green, is the optimal colour.

Background colour

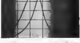
The text on the screen should not contrast too sharply with the background colour. Yellow brown provides a restful contrast.

Focussing

The symbols on the screen should be stable and properly focussed to provide absolute definition, which is essential if the text is to be read with the minimum of effort.

Variable intensity

It should be possible to adjust the intensity of the text so that it can be adapted to the lighting in the room.



The sensitivity of the eye varies in different wavelengths. In addition the sensitivity of the rods and cones varies. The yellow wavelengths, with a tendency towards green, have proved themselves to be the most suitable.

The symbols on the screen are built up on a matrix. Too coarse a matrix means unclear text that is difficult to read.

Contrast improvement

If lower overhead lighting does not provide sufficient contrast improvement the screen can be fitted with a hood. Some computer terminal screens have them fitted as standard.

Reflection free

The tube, or the protective glass screen should preferably be anti-reflection treated. If the screen can also be individually angled/positioned by the user, reflections and mirror images can easily be eliminated.

Satisfaction & Security

Territory

It is not only the physical circumstances which determine whether or not a person thinks he has a functioning workstation. It is also a matter of satisfaction and security. Some people like to work reasonably isolated. For others, this is absolutely essential owing to the nature of their work. Some people work better together with other people in groups and teams. In one way or another, however, we all need a certain amount of 'territory', the extent of which cannot be reduced.

It must be possible to adapt a terminal system to these desires and needs. It should be possible for the user to decide on the position of the workstations in the room and of the units on the table, otherwise the system does not satisfy the conditions that can reasonably be placed on it.

People select the temperature

Generally speaking the temperature in a room should be right for the work being performed there. For office work 20°–22°C is suitable. Then each individual can regulate his own temperature by wearing thinner or warmer clothes.

If the temperature gets too high the body cannot get rid of excess heat. The body temperature rises, the heartbeat quickens and you get tired and listless. This happens when the premises are badly ventilated or are too small. It is even more evident if several heat generating units are placed in the same room. Locating the computer and similar equipment away from each other can be one way of eliminating this problem.

Stress, for Good and Evil

Stress – in just the right amounts

People have a sort of equilibrium condition, which varies from one situation to another, and of course from one person to another. If we are exposed to changes in our circumstances this equilibrium is disturbed and we can experience stress. Some people are more susceptible to such stress than others. Some can take it better than others and have a higher tolerance threshold.

An existence entirely free of stress is almost utopian. Stress in just the right amounts creates that general liveliness which is so essential for an active life and work. However, stress should not be too prolonged, too sharp or too frequent.

Among the common causes of stress that we are exposed to are too many and too tough demands, being in too much of a hurry and trying to do more than we can really cope with.

But there is more to stress than pressure. For example, having to wait too long for various events around us, such as a reply from a computer terminal. Another typical situation is having a queue in front of you which is too long, and everybody is expecting an answer from you. You yourself have to wait for the computer to answer your questions, which always takes longer than normal. So, you cannot influence the answering time. Simply wait. And wait. And if the answer time varies widely from one time to the next this also causes stress.

Irritation, impatience and anger can all produce stress symptoms, among others a rise in the blood pressure, increased heart activity and increased muscular tension in the neck and shoulders.

Fear in the face of change

When we begin to work with terminals many of us are afraid of making mistakes. We feel completely alienated, full of awe for the computer and the terminal. We can't imagine the horrible consequences of incorrect data. Such a situation is also felt to be extremely stressing.

A change in the content of the job, for example through the introduction of data processing, is also a cause of anxiety.

The job must not be impoverished

It is important for the decision makers not to let themselves be blinded by the power of the computer. Efficient, streamlined procedures may look good on paper but they can turn out rather differently in practice. A result which initially looks brilliant can appear quite different in the light of everyday reality. Impoverished tasks and jobs cannot provide the job satisfaction and stimulation that people need. It is difficult to create lasting motivation in a monotonous existence. But uninteresting jobs still have to be done. The dull tasks that remain, despite all efforts and job satisfaction campaigns, can be improved by being limited in time through job circulation or a change in routines.

Many causes of tiredness

Tiredness is another sympton with many imprecise causes, and many operators feel tired at or from their work. Most often it isn't clear whether it has purely physical causes – vitamin deficiency or anaemia – or if it is a result of the work itself. The first possible cause can be checked medically, while the second is much more difficult to identify. Are the

lighting conditions correct? What about the working positions? Noise levels? What is the nature of the work regarding the handling of documents, working with the console and reading the text on the screen?

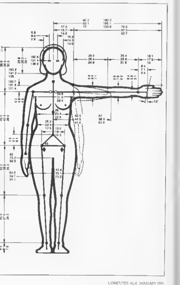
Working positions: Everybody's own private concern

The chair

The chair has a really central function in a workstation. It permits a correct sitting position, so that the load on the hindquarters is minimised. The seat and the backrest should make possible a tension free and restful position, and permit variations in the sitting position. It should be possible to adjust the height of the chair quickly and easily, especially if several operators use the same terminal. The height is correct when the entire sole of the foot can rest on the floor or footrest and the height of the chair is adjusted so that the crook of the knee is a centimetre or so away from the edge of the seat. Then the circulation of the blood to the lower leg is not hindered. Armrests may be needed in certain circumstances, while in others they are an obstacle. This should be decided from case to case. If the chair is to provide effective support it should not have wheels.

Adjustable table height is best

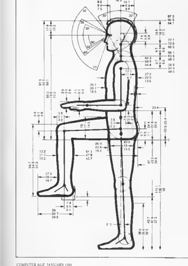
If the height of the tabletop can be adjusted you should start with the floor as the support and adjust the chair as described in the preceding section. Then the



height of the tabletop should be adjusted so that the elbow forms a right angle with the forearm parallel to the top of the table. In this position there is good freedom of movement and the least load on the muscles. If, on the other hand, the height of the table is fixed, start from that and adjust the chair height so the arms are correctly positioned. Then use an adjustable footrest which suits the length of the operator's leg. The footrest should be stable and have a spacious horizontal surface for the foot.

Symmetrical sitting position

The basis for working at a terminal should be a tension-free average medium position which is symmetrical, ie not bent or twisted in any direction. Bending or turning mean extra loads on the spine and the muscles.



Equipment should be individually positionable

In order to obtain a functionally correct workstation the equipment must be placed so as to make possible individual positioning. If the units are not placed to suit the individual the static load on certain groups of muscles can give rise to unnecessary tiredness. But there are also other reasons for choosing equipment which allows flexible placing of the various units. The nature of the work may vary and the routines may vary. Different individuals have differing needs, not least in view of the fact that some people are left handed and others right-handed.

Workstations where writing and console work will be done at the same time require different levels for the writing surface and the console. This often leads to a more or less permanent position for the console. Each individual and the arrangement of the work, in other words, requires thorough study if the most suitable and restful workstation is to be obtained.

Other activities apart from writing, such as handling papers, may also be best performed if the various surfaces of the table are at different heights. There are computer terminal tables whose height can be adjusted in this way.

Units often used close together

Work which involves comparing documents and the text on the screen needs the documents and screen close together. When recording data from documents via the console "looking at the documents" is often the main part of the work and should therefore decide the position of the units.

Various types of manuscript stands can be used to cut out neck twisting. In general the way people work with documents is treated in an old-fashioned way and should be given more attention.

Terminal Tables and Other Tables

When a workstation is being designed the aim should be a functioning whole. If the nature of the work changes at one and the same workstation it is essential to have a design which allows individual adjustments. The same is true if different operators use the same workstation.

In principle each new work situation should be studied before a suitable workstation design is settled. For some sorts of frequently found workstations there is plenty of experience to learn from, while completely new situations require special study.

Terminal tables

Specially designed terminal tables are generally better than normal tables. The table surface should be large enough, but not too big, and of a colour with the correct luminance in relation to the input documents. In addition, the table surfaces should be laid out to suit the terminal units and the reach of the operators. The table height should be readily adjustable for individual positioning or an adjustable footrest should be provided. Occasionally some types of equipment can be built into the table top, such as consoles, screens and printers. Various sections of the table should be capable of separate adjustment. Cables and other accessories should be concealed.

Special tables

In some applications completely purpose built tables may be needed, for example for teller terminals in banks. In these special cases an ergonomical and functional evaluation is made right from the outset and the furniture can then be constructed according to specification.

Lots of things can collect on a table

First of all the various units of the terminal should be on the table top. Examples of such units are: one or possibly two consoles, display screen, light pen, magnetic card reader and printer.

Then come the documents, other information, and possible reference material. A tabletop stand may sometimes be needed for documents. For some types of work there will be a telephone and a separate calculator. Finally, and by no means least, a number of personal belongings which are absolutely indispensable.

Where all these things go is a matter for the individual to decide in the light of his situation, the nature of the work and his/her personal needs.

Ergonomics

Organize your Working Surface

It is really a matter of organizing the working surface so that it suits the individual and the tasks being done. When placing the units they are positioned on the basis of the reach of the operator once the chair and table heights have been correctly adjusted.

Often-used units closest

All the frequently used units should be placed in the area that the arms can reach with the elbows remaining close to the body. This is called the close area.

Maximum reach area

The next area is all that the operator can reach by stretching out his/her arms, with a third area which can be reached if the operator leans forward. The last two areas should be used for units which are not used very frequently. If they are only stretched infrequently the muscles have time to recover and the movement can be regarded as a natural element in dynamic sitting.

Control of the operator's work

In recording input data it is often the documents which steer the operators. They can be anything from bulky lists to small slips. In this type of work document handling is important, as is having the minimum field of movement and vision.

With enquiries or order booking the work is steered by incoming telephone calls. The telephone – console – screen are the most important components, and they should be in the close area.

Some terminals are used while the operator is facing the customer. In such cases the visual contact with the customer, handling objects connected with the customer, such as money or tickets, is often the most important factor, while the terminal plays a secondary role. So the units should be placed accordingly. The otherwise standard central position of the terminal screen is definitely unsuitable.

How often is the terminal used?

The same line of reasoning as in the first section can be used, but this time for frequency of use.

Terminals which are to be used for intensive work must be given the maximum attention as regards function and ergonomics. The interaction between man and machine will be really put to the test, and so the positioning of the equipment is very important.

Even if the terminal is to be used on a part time basis or for variable routines, or is to be used by several operators, all the equipment should still be placed within a convenient working area.

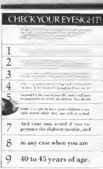
For terminals which are used irregularly it is not so essential to follow all the recommendations slavishly, and the occasional compromise with the highest ergonomic standards can be allowed. But the target should always be the best possible design. If the equipment can be moved to one side then a workstation equipped in this way can serve a combined purpose.

The Hands do the Work

The position and movements of the hands and fingers are of great importance for the design of workstations and consoles. It is through the fingertips that the operator has contact with the computer. All instructions and data have to be fed in via the console.

Straight recording is the toughest

The straight recording of data – data acquisition – is generally regarded as highly intensive work. In such cases con-



CHECK YOUR EYESIGHT!

1

2

3

4

5 harmed for the rest of your life and it will later be impossible to rectify the defects. You should

make it a rule to have your children's eye sight tested while they are still at school

7 And your own tested if you experience the slightest trouble, and

8 in any case when you are

9 40 to 45 years of age.

DID YOU KNOW...

Light

Sound

Taste

Smell

Touch

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MEMORIES	
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4027	[illegible]
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The Nascom 2 kit is supplied complete with construction article and extensive software manual for the monitor and BASIC.

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16K RAM Board £140 + VAT
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£345 Built [illegible]

£295 Kit

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The Nascom IMP (Impact Matrix Printer) features ● 60 lines per minute ● 80 characters per line ● Bi-directional printing ● 10 line print buffer ● Automatic CR LF ● 96 characters ASCII set (includes upper/lower case $ £) ● Accepts 8½ paper (pressure feed) ● Accepts 9½ paper (tractor feed) ● Tractor pressure feed ● Baud rate from 110 to 9600 ● External signal for optional synchronisation of baud rate ● Serial RS232 interface ● Ribbon cartridge £6.60 VAT 50p P&P ● 2000 sheets Fan Fold paper £18.00 VAT £2.50 P&P

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siderable attention must be devoted to the design of the workstation

The console must be capable of individual adjustment so the fingers and hands can be moved quickly without hinder The table if there is one must also be adjustable so that the forearm is parallel to the tabletop

Document handling must also be performed smoothly A supporting edge for the hand between turning over the pages can be a good idea but otherwise the arms should be kept free and symmetrically positioned in order to avoid a twisted position for the back

Different functions

For other functions, eg seeking errors the workstation is used in a quite different way Often the material worked on is an error list or files The text on the screen is now more active and the data input is often alphanumerically oriented For the most part the operator sits with his/her hands in the typewriting position and with the console directly in front of him/her Even so, flexibility is still important to retain the ability to change the positions of the units from one occasion to the next

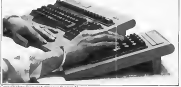
Workstations with less frequent tasks

Workstations which are infrequently used or which are used by several operators can be designed for standing work which makes a worthwhile change from all the sitting as far as the operator s back is concerned This may be suitable for enquiry terminals

A small number of keys are pressed After a wait of a few seconds the desired information can be read on the screen/printer The placing of the console no longer has the same high priority as for a data recording terminal as the muscles have time to recover between use In these situations it is often the customer contact, handling of money etc, which is of more importance

Small details

A console with a standard national typewriter keyboard layout means the shortest learning time If the functional keys are a different colour they are more easily identified which in turn means less mistakes

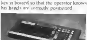


Console of the Datasaab Alfaskop System 41

The keys should be at least as big as a fingernail, while the layout of the console should be compact so as to reduce hand movements

If the keys are slightly concave they feel good, even at different angles

Some keys should be more concave than the others namely the 'home keys – F and J On a numerical console the 5 key is bossed so that the operator knows his hands are correctly positioned



Console of the Datasaab Series 16

Angle of inclination

The console should not be too steeply inclined as this means the wrists will be too bent.

A slight inclination means that the most distant row of keys can be reached comfortably and that only a slight turn of the wrist is needed to reach the nearest row of keys The more intensive the work at the console the more important it is to be able to adjust for the correct angle of inclination

Height of console

Just as important as the inclination is the height of the console as this determines the angle of the wrist In some workstations the console should be sunk into the tabletop Too high a console will mean an extra load on the arms and neck

Separate consoles

The console should not be integrally constructed with the screen as this completely eliminates the possibility of individual adjustment A movable console makes it possible to vary or change the sitting position when necessary

The height angle of inclination and position of the console are important parameters for effective and restful work at the console It must be possible to reach the back row of keys comfortably while still being able to reach the nearest row with a simple turn of the wrist

Illy Johnson demonstrates one of the exercises devised by Datasaab

Muscles love Movement

The work at a terminal or other computer based workstations can cause load problems and it is best to be aware of these matters when designing the work stations Apart from the question of vision and lighting conditions there is also the job of dealing with the problems that are caused by a lot of sitting and incorrect movement patterns The wrong sitting position and working technique can result in aches in the neck shoulders and arms

Vary the work

Normal muscular activity assumes varying tension and relaxation This stimulates the blood circulation The muscles obtain a supply of oxygen-rich blood and can get rid of impurities

If the muscles are loaded continually without any chance of relaxing, the blood circulation is restricted and the muscles quickly get tired

Or, in ergonomic terms, the operator

Let's start with some eye exercises Look left then right a few times Then upwards and downwards It makes a change from staring at the console all the time!

should sit correctly, have the right working height with the equipment and documents placed for the minimum of movement The workstation should also be individually adjustable while still stimulating a dynamic pattern of movement

Breaks and exercises

Whatever way we sit it will still do the body no good The blood circulation requires stimulation The brain and the muscles need fresh oxygen and we get that by changing our working position

You can benefit even more from a complete set of exercises in a break Datasaab has produced a poster showing a suitable exercise programme

Take a few deep breaths Stretch your arms and legs

Take breaks Do some exercises and relaxation movements now and then Why not have a regular programme of exercises which everybody who wants to can join in To give renewed strength to body and mind

Sound & Noise

What is sound?

Sound is energy in the form of wave movements in the air which spread out from the source of the sound to our ears The sound waves make the eardrums vibrate and these vibrations are converted by means of an ingenious transmission system in the inner part of the ear into nerve impulses The volume of sound is measured in decibels

What is noise?

Noise is the name we give to unwanted sound The volume of noise is also measured in decibels and 3dB represents a doubling of the intensity of noise The amount of noise is measured in watts

The risk of injury from noise increases the longer you are in the noisy environment The more disturbing the noise the more the capacity to work is affected and the worse the work environment is considered to be Irregular noise is more harmful than regular noise, and high frequency noise is said to be more harmful than low frequency noise Weak sounds can also be experienced as noise Take for example the sound of a dripping tap at night Different people can put up with noise to different degrees So it is difficult to lay down any hard and fast rules about noise and the damage caused by noise

Terminals and computers make noise More or less

Nevertheless, people find it difficult to work in a completely silent room But there aren't many of those around, except perhaps in the controlled test environment Background sound must exist, and does It comes from external sounds the wind rustling of paper the aircondition-

ers people in the distance, cars outside, and much more

And on top of all this with computers and terminals coming into the office, they bring new sounds The sound of keys being depressed, fans and printers It is important to limit these sounds right at the outset And it should be possible to dampen them even more later if necessary

The keys on the consoles should function quietly But the console should not feel completely dead Otherwise the brain fails to register the right feedback. This can be achieved by using a weak acoustic signal or in some other way

The basic construction of the equipment should be such that it can be used in a normal office environment The noise levels must be kept within acceptable limits Alternatively, some units can be placed in a separate room, behind sound-absorbent screens, or provided with extra hoods

If you and your colleagues are disturbed by the noise in your office you should engage a consultant with the appropriate measuring instruments to propose concrete action to correct the problem The layout of the room, the ceiling, curtains placing of partitions, and many other factors all effect the spread and distribution of noise

Decentralization reduces the problem

With modern terminals there is no need for all the operators to sit together in the same place Flexibility and simple cable connections make more individual arrangements possible This in turn means better opportunities than before to reduce noise The company and its employees should all be able to have their needs met ■

About Datasaab

● Datasaab is the name of a new company formed at the beginning of 1978 by merging Stansaab Elektronik AB with the Datasaab Division of Saab-Scania AB Jointly owned by Saab Scania and the Swedish State the new company represents a consolidation of Swedish EDP technology and experience and has the financial backing necessary to maintain a leading position in the rapidly growing EDP industry

Datasaab systems are developed and produced at the company's offices and factories in Sweden and exported to a number of different countries throughout the world Datasaab subsidiaries are responsible for the marketing and maintenance of company systems in the major European and American markets

Datasaab has pioneered the production and development of distributed data processing systems which provide access to the power of the computer where it is needed For more information contact Datasaab at 72 Northolt Road Harrow Middx HA2 0HE Tel 01-422 3442

Next issue An article on stress

TEST YOUR WORKSTATION.

Here is a simple check list to use when you check your work environment and workstations If you want more details about what each heading involves they can be found in the appropriate section in the brochure

External environment
- ☐ Screened windows
- ☐ Non-glare overhead lighting
- ☐ Walls not too light
- ☐ Balanced contrasts
- ☐ Subdued overhead lighting
- ☐ Comfortable temperature
- ☐ Low noise level

Workstation work
- ☐ Placed to meet individual needs
- ☐ Varying work
- ☐ Stimulating tasks
- ☐ Breaks

Console
- ☐ Movable
- ☐ Inclinable
- ☐ Low height
- ☐ Clear symbols
- ☐ Not too light in colour

Screen
- ☐ Reflection-free
- ☐ Restful picture for eyes
- ☐ Well focussed symbols
- ☐ Variable light intensity
- ☐ Separately adjustable caption brightness
- ☐ Hood

Chair
- ☐ Adjustable height
- ☐ Adjustable backrest
- ☐ Restful seat
- ☐ Armrests where necessary

Table
- ☐ Adjustable height
- ☐ Large enough working surface
- ☐ Individual placing possible
- ☐ Space for sunk console
- ☐ Document stand

VIDEO VECTOR DYNAMICS LTD
39 Hope St., Glasgow G2 6AE;
Telephone 041-226-3481/2

WE SELL SOLUTIONS Have you discovered that your problems really begin after you've bought the hardware? Either you've bought the wrong hardware or no software exists to make it work properly. We specialise in providing total solutions to problems and professional after sales support of hardware and software. We have the resources necessary to implement commercial, scientific and instrumentation projects.

COMMERCIAL Typical of our recent projects in this area was the connection of 12 remote stations to a central unit. This was achieved by using Commodore Pets as the remote stations allowing a degree of local processing linked via modems to a central S100 microcomputer with substantial disk storage capacity. This type of configuration is ideal where a limited amount of local accounting is required at each site but with a central compilation of information on stock, payroll, etc.

SCIENTIFIC Our scientific packages are currently in use by a number of major multi national companies. Typical of these packages is our Chemical Graphics System used by pharmaceutical companies in drug design. This is designed to run on PDP 11 configuration.

INSTRUMENTATION/CONTROL We can supply a complete range of hardware and software packages covering analog, digital and graphical input output and logging using fast microprocessor based systems.

COST Due to our familiarity with a wide range of hardware we can supply systems either optimised for minimum price or maximum performance — you decide on the price performance mix.

In addition to consultancy and turnkey packages we offer the following proprietary products

FASTLIB This package is based on the AMD 9511 arithmetic chip and is a complete hardware software system. Use of FASTLIB is completely transparent to the user of Microsoft FORTRAN. The software is totally integrated with the FORTRAN compiler and simply by replacing the Microsoft supplied library by FASTLIB existing programs can run 5 - 20 times faster without any modification. The hardware requires a single S100 slot. In addition to enhancing the speed of execution of the existing FORTRAN functions and operations additional functions have been implemented — NINT TAN ASIN ACOS SINH COSH THAN & RAN (a pseudo random number generator).

GLIB A graphics library enabling complex pictures to be produced from a series of simple subroutine calls such as VECTOR (draws a line between any two (x y) points) CIRCLE (draws a circle of any radius centered on any (x y) point) TEXT (plots a 64 character ASCII set) STEXT (plots Greek and Mathematical symbols) etc. Plots can be saved on or retrieved from disk by single subroutine calls. The standard package uses the Vector Graphic High Resolution Graphics board. Microsoft FORTRAN or MACRO is also required.

PRICE LIST

HARDWARE

North Star Horizon 64K, 2 Quad Capacity drives	£2360
TVI 912C VDU	£ 595
Anadex DP8000 Printer	£ 525
Anadex DP9500	£ 895
NEC Spinwriter daisywheel printer (RO)	£1775

SOFTWARE

All Digital Research, Microsoft, MicroPro etc software supplied – call for prices

PACKAGES

FASTLIB / MSP9500	£ 495
GLIB	£ 500

SPECIAL OFFERS

Word processor –
64K, Quad capacity drives Horizon with TVI 912 and NEC Spinwriter complete with CP M2 and MicroPro Wordstar
ONLY **£4730**

*MemTech APU boards – limited numbers available going-cheap

STOP PRESS Our own 48K dynamic RAM board now available at a price of £300. Full IEEE S 100, Z 80 refreshed bank selectable, 200ns access time (equiv to 5 MHz) – designed and manufactured in the U K

***NEW** OLYMPIA Daisywheel Printer RO **£850**
KSR **£998**

ARRAY Processing from Silicon Glen on the West Coast of Scotland

VIDEO VECTOR DYNAMICS Ltd announces what will be one of the most significant innovations in microcomputing during the 1980's — the VP 9500 vector processor. The VP 9500 is a British designed and manufactured vector processor consisting of a two to 16 long vector of pipe lined floating point processors with individual data stacks, optimised to operate on arrays of floating point numbers of up to 16 384 elements. The VP 9500 provides floating point processing at up to 200 times faster than ordinary 4 MHz Z 80A microcomputers and 20-30 times faster than a PDP 11 34. The benchmarks on which these figures are based may be obtained on request.

The VP 9500 is constructed on one (up to 8 elements) or two (3 to 16 elements) glass fibre PCBs with full solder masking and silk screened component locations. The precision board lay out was generated on a CAD facility and etching was performed for us by the U K's leading PCB manufacturer. The VP 9500 has its own on board crystal clock and DIP switches allow it to be placed anywhere in the I O space of any S 100 microcomputer running at any clock speed.

Every VP 9500 comes complete with VPLIB, our library of Microsoft FORTRAN callable array processing routines. Typical calls to FPLIB are CALL VSQRT (A,C,N) where the square roots of all of the N floating point numbers in array A are calculated and placed in array C, and CALL VMUL (A B C N) where the N elements of array A are multiplied by the corresponding elements of array B and the results stored in array C. VPLIB contains over 100 such routines.

The VP 9500 is designed for those high speed, computationally-intensive tasks such as real time collection processing of video data, finite element analysis, crystallography, molecular modelling, graphics, signal processing and large-scale scientific engineering calculations which are beyond the capabilities of conventional micro and mini computers.

All VP 9500s are field upgradeable to the top of the range VP 9500, an S 100 EPROM card containing complete diagnostic software, a scalar FORTRAN library FASTLIB which replaces Microsoft's FORLIB by calls to the VP 9500 in addition to providing extra FORTRAN functions (TAN ASIN ACOS SINH COSH NINT & RAN), custom additions to VPLIB and full maintenance contracts.

And the cost? From approximately £1,800 for a VP 9500 2 through £3 400 for the VP 9500 8 and up to £5 800 for the top of the range VP 9500 16. Complete microcomputer systems in our MVP range include the MVP 9500 16 based on a 64KB hard disc Z 80A microcomputer and VDU and software for around £11 000. This is £6 000 cheaper than PDP 11 34 system (20-30 times slower than MVP 9500 16).

Martin Hewitt & Tim Smithin

How to Cope

Managing with Computers

As the cost of computer technology falls, especially with the advent of micro's, businesses increasingly invest in computers of one sort or another. Computer hardware is becoming a common feature of the modern office. No longer are computers mysterious, precious entities sealed away in dust-free rooms; they are becoming as versatile and robust as the office typewriter. The computer then is just another tool, but are managers making the best use of it?

The computerisation of office records, payroll, and stock control are familiar applications, which use the computer as a storage device and 'number cruncher'. Whilst these applications have often proved effective and have introduced significant cost savings, are they the only things that modern software can do?

Many of the problems that managers face today are more messy than the familiar applications might imply. They often involve complex judgements and careful sifting of opinion. The manager does not usually have many tools to help him with this type of decision. Can the office's latest tool, the computer, be of any use in this arena?

In this article we describe how our research group at Bath have developed an approach to helping managers which is designed to assist them with the more complex, messy problems. This involves unique computer software called COPE (COgnitive Policy Evaluation) which runs on a mini computer; a smaller version is being developed for micro's. It offers the manager a way of describing his problems and exploring possible courses of action. We believe it to be a powerful way of tackling complex issues by making use of widely available computer technology.

This is demonstrated by our being able to use this approach and the software in a variety of organizations, and for a wide range of purposes. For example – •to help an editorial team re design a magazine – •to assist an international furniture company with their saw-purchasing decisions – •to help a local government department develop strategic plans – •to help a local community group plan their activities.

In all these activities we were particularly encouraged by the commitment and enthusiasm which our approach and software generated.

Cognitive mapping

The heart of our approach and the COPE software is a process we have developed called *cognitive mapping* which, as its name suggests, is a picture of ideas and beliefs and how they relate to one other. We like to think of it as a way of enabling a decision-maker dump some of his ideas out of his head, so that he can look at them more carefully and systematically then he might otherwise be able to do unaided. In the same way that a pencil and paper can be a big help in doing a long division sum, a cognitive map can be an aid to setting out the issues and problems more clearly and explicitly. This allows the possible implications and consequences of a decision to be examined. No doubt, when facing a complex, worrying decision we would all echo the words of the poet Stephen Spender that '*My mind is not clear, my will is weak. I suffer from an excess of ideas*.'
How useful it would be if we had a way of freeing our minds of some of this jumble and examining it more thoroughly.

Aiding decisions

To illustrate this process, let's look at a decision a manager might face and see how it works in a little more detail. Suppose a small firm has decided that computerisation is worthwhile. A further choice they might face is whether they should opt for the newer and cheaper technology of a micro, or the larger mini computer system. Clearly this will depend both on a careful technical appraisal and on persuading others in the organisation to support the choice. The diagram (Figure 1) indicates some of the chains of thought which might be involved in thinking about this decision. They are taken from some work we have done in assisting a partner in a small firm to consider just this issue.

The problem is represented by the concept –
Purchase a mini ... purchase a micro
It is represented in a form with two contrasting poles. This 'bipolar' representation is very important since the phrase 'purchase a mini' *on its own* could be ambiguous. It might mean –

- Purchase a mini *rather than* purchase a micro
- Purchase a mini *rather than* carry on

with a manual system

- Purchase a mini *rather than* invest in a mainframe

This sort of representation gives a better feel for the intended meaning and the possibilities that the individual sees in the situation. The relationships between concepts are shown by arrows and the plus or minus sign attached to them. So, for instance –

micro s are new technology … *mini s are established systems*

↓+

May be unknown bugs … *easier implementation and running*

is intended to express the beliefs that – micro s are new technology may lead to 'unknown bugs', and conversely, that 'mini's are established systems may lead to easier implementation and running". A minus sign indicates that the first pole of one concept leads to the second pole of another for example –

Bill will press for a micro

↓–

Purchase a mini … *purchase a micro*

suggests that Bill will press for a micro may lead to purchase a micro

In the cognitive map we attempt where possible to keep to the phrases and words used by the person whose map it is, rather than impose strange words upon him. The map and the process of building it by making ideas explicit is an important part of thinking through the issue in a new way and recording the ideas as we go along. Once ideas have been dumped out in this way they are more readily available for recollection and consideration.

In much of our work maps have frequently been extended and elaborated. For example in this case the concept 'Bill will press for a micro" led to a consideration of what might be done to persuade Bill to change his mind and buy a mini and what consequences might result from going against Bill's wishes. It also became clear that the potential problems associated with micro s needed to be more carefully investigated.

'the starting point for discovering errors, finding better ways of doing things, improving decisions, and developing beliefs.'

This picture captures both potentially quantifiable aspects of a problem, and belief opinion and internal politics that might be involved in a decision. It thus captures a richness and authenticity which a purely quantitative model does not possess. It is not intended to be a picture of what is right or wrong, but what the manager concerned believes to be the case. This seems crucial to helping the manager with his problem. It is his problem we have to tackle, not our interpretation of it. We all have opinions prejudices and things which are dear to our hearts, our actions will in part be based on these. Of course we may be foolish or mistaken, but if a manager is to use his cognitive map, it must represent the world as he believes it to be. This can then be the starting point for discovering errors, finding better ways of doing things, improving decisions and developing beliefs.

Many situations are less clear-cut than the one discussed here, and in practice cognitive maps are much larger than the one shown in figure 1. Commonly they contain 300 – 400 concepts and 500 or more relationships. When they reach this size, manual maps are less easy to use, and we have developed extensive computer software to manipulate the maps. The software also offers a large number of facilities for analysis.

Computer maps

In the first instance, input to the computer may begin with a small hand-drawn map of the core of the issue. This often helps managers to get started. Data is input simply as shown below.

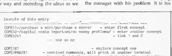
Gradually this may be expanded by talking around various aspects of the problem. As the data is fed in it, it is checked for accuracy and frequently referred to and this often stimulates further thought.

Once the manager has entered sufficient data, he can *explore* the consequences of a decision for all other things that matter to him in his model: this is a **Trace**. He can also look for connections between particular concepts (**Routes**) select key concepts and see which other concepts are linked to them (**Automatic grouping**) explore the map for **feedback loops** (vicious circles in his chain of thinking), collect together all concepts referring to a particular item (**string/search**), build up sub – models to examine more closely (**sub-systems**) and many more. He does not even have to be around to do it, since through the COPE macro command, he can build up a file of commands and then set these to run over night (ideal for a busy manager).

The problems of using computers

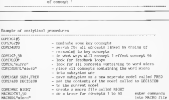
In our work we have been aware that most managers are not accustomed to regular use of computers and often experience problems which may make computers seem unattractive and difficult to use. Such problems vary from unfamiliarity with a keyboard to difficulty with the format or rules of a software package. In programming COPE we have attempted to overcome some of these problems and make the model more useful and useable to the decision maker.

This means that the design for COPE specified •little typing in as possible •acceptance of any input at any time •robustness against 'silly' errors, •easy recovery from mistakes, and •extensive



```
Example of data entry
------------------------------------------------------------------------
COPE>1=/purchase a mini/purchase a micro/    - enter first concept
COPE>2-/capital costs important/no money problems/ - enter another concept
COPE>2+1                                            - link 1 and 2
                    ::: and so on

COPE>X1                                - explore concept one
COPE>PMAPX1         - combined commands, will print at another terminal
                      in map format the concepts contained in the exploration
                      of concept 1
------------------------------------------------------------------------
```



```
Example of analytical procedures
----------------------------------------------------------------------
COPE>G1#5
COPE>G2#9                 - nominate some key concepts
COPE>AUTO                 - search for all concepts linked by chains of
                          - reasoning to key concepts
COPE>C1,56                - in what ways will concept 1 effect concept 56
COPE>LOOP                 - look for feedback loops
COPE>L"micro"             - look for all concepts containing to word micro
COPE>SUB1L"micro"         - place all concepts containing the word micro
                          - into subsystem one
COPE>SAV SUB1,FRED        - save subsystem as a new seperate model called FRED
COPE>ADD DECISION         - add the contents of the model called to DECISION
                          - to the current model
COPE>MAC NIGHT            - create a macro file called NIGHT
MACRO>TR1,50              - do a trace for concepts 1 to 50      enter commands
MACRO>L"micro"                                                   into MACRO file
MACRO>SUB3LOOP
COPE>
COPE>@NIGHT               - set the macro file to run eg  overnight
----------------------------------------------------------------------
```

graded help messages All this is intended to make COPE useable to a person who has no experience of computers But the structure must also be designed for an experienced user to make full use of it Thus the simple commands can be built up by the experienced user into more complex operations There are also available a powerful set of analytic aids

To achieve these aims COPE runs interactively with a simple hierarchical command structure At the prompt "COPE>" the user may type any of the COPE commands Commands are up to 4 letters and can be combined to form more complex instructions The system is well protected against invalid commands and potentially dangerous instructions Concepts and links may be entered at any time and the effect of changes made can be viewed instantly

In this way the model can be gradually built up, checked and corrected as it is being constructed When using many models especially the more familiar 'number crunching' models the manager frequently finds that he has to squeeze his problem into the model But this often means that the problem is not fully described With COPE the reverse is true there are no predefined variables and no set structure The concepts are the phrases which the manager uses to talk about the problem The aim is for the manager to recognise that it is his problem which is being worked on, and not some foreign mathematical abstraction

We have found that this approach stimulates new ideas around the problem, and new concepts and links can be added or changed so that eventually the model more closely represents the decision maker's thinking around his problem

Graphics

But keyboards are often awkward to work with Our recent developments have therefore included the use of a Graphics terminal (DEC GT41), to display the maps in the same form as diagram 1 A large model can be viewed in continuous sections and the map shows up to 15 concepts and their links at a time with pointers to where the next links are, and commands to scan a larger section of the map and bring it into view

With the graphics terminal in operation all commands can be initiated with a light pen, by pointing at a menu of commands and then the desired concept The keyboard becomes redundant for exploring the map To back up the graphics we have a high quality printer (Diablo) which has programmable reverse paper feeding and right and left printhead movements this can be used to produce copies of a particular map It can also produce larger maps than the smaller graphics screen

Both these facilities rely on moderately expensive equipment but the recent advances in low cost graphics/v d u terminals mean that this sort of capability will soon be available to most users especially as printers of the Diablo type are common accessories to word processing systems In this way these exciting techniques for using the model and producing understandable output are now becoming accessible to most computer users

We have found that the presentation of a map in the picture form helps most people visualize their model much more easily and absorb the relationships and their implications more quickly To many it is a much more digestible output than reams of conventional printout

Exploring and getting information out of the model is much improved but building it can still be a problem typing in '1= etc can be off putting We have partly improved this by adding an automatic numbering facility but more is needed We are currently producing a version of COPE which enables the user to think about and build up his model in an even less constrained way by constructing the model through an interactive dialogue in which the manager need only respond to questions and enter phrases If we can generate this kind of relationship between man and machine then we have gone some way to fulfilling our aims for friendly and relevant software

The result of trying to produce flexible software of this type has been that people are keen to use COPE in a wide variety of environments and for many different problems We are particularly encouraged that it has found many adherents in the commercial and industrial world as well as academic and educational institutions

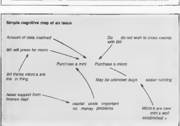
No longer (we hope) are computer packages something which never quite do what you wanted or something for which you spend days reading the manual and still get nowhere We hope that our clients can readily see their problem being represented by the model and can simply and straightforwardly explore, change and analyse their model without recourse to manuals or expert advisors

In conclusion

The aim of our work has been to enable managers to make even more use of computer power which most companies now have available in some quantity We seek to find new ways of analysing problems by building models of the manager's own thinking around an issue We feel that this is, in itself new in the business and industrial world

But as well as making models themselves more real to the user, we hope to remove the computer entirely from the consciousness of the manager Many software packages put irritating and unnecessary constraints on the user (often just to ease the programmer's job) if we can remove these then the user can concentrate on the model and not the machinery When we manage to forget the computer, then we can begin to manage with computers ■

```
Examples of changes to the model
------------------------------------------------------------------
COPE>D4                  -   delete concept 4
COPE>C3                  -   explore the consequences of concept 3
COPE>D3-6                -   delete the relationship between 3 and 6
------------------------------------------------------------------
```


Simple cognitive map of an issue
Amount of data involved
Do do not wish to cross swords with Bill
Bill will press for micro
Purchase a mini
Purchase a micro
Bill thinks micro s are the in thing
May be unknown bugs easier running
Need support from finance dept
capital costs important no money problems
Micro s are new mini s well established

Acknowledgements

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Original system design and development by Jim Wiltshire

The authors are at the Centre for the Study of Organisational Change and Development The University of Bath Claverton Down Bath.

THAT FIRST COMPUTER

Part II

Let Suppliers Know What You Want

John Maclean after graduating in Mathematics from Lancaster University spent a number of years in the aerospace industry where he was involved in programming and project work. He also lectured in mathematics and computing at Preston Polytechnic.

He joined NCC at the beginning of 1978 as a Senior Consultant in the Courses and Advisory Services Department and has been involved in a number of short advisory assignments particularly for first time users

If you found the process of learning about computers and deciding to invest in one difficult then the stage of actually selecting the right system for you can be seemingly impossible There are literally hundreds of suppliers of computer systems offering a wide variety of computers ranging from small desk top micros to relatively large and expensive small business systems each with a range of applications software But which would be the right one for you? How do you 'home-in on those suppliers who could offer you a suitable system for your requirements?

How not to approach suppliers

There are a number of possible ways of answering these questions - or not, as the case may be

- You would ask around your local business acquaintances and see what systems they have and what they think of them
- You could carefully set down your requirements in a tender document and then select the potential suppliers by setting down a basic list of criteria that must be satisfied before you will consider them
- You could take a pin open the Yellow Pages at the appropriate point and close your eyes

Without giving the game away let us look at the first and last of these methods and see why they are not to be recommended Firstly the 'stick a pin in' approach

This is a bit like ringing up your local butcher and saying you want some meat! Of course, the butcher will be able to supply the meat and if he wants to he can possibly do a hard sell of two t-bone steaks that he happens to have left Unfortunately since you hadn't told him that you wanted a Sunday joint to feed five people two of whom don't like beef, you can't expect him to provide you with exactly what you want. Likewise, if you simply ring up your friendly computer supplier he will be only too pleased to offer you an ICR 300 SX with twenty-three special bells and whistles and an assurance that it is exactly what you want

Unless you have set down clearly and comprehensively what you want then you can neither expect him to offer a suitable system nor assess the suitability of his system yourself

Likewise the first method, of asking around acquaintances is likely to be of little value since the system that you may require is unlikely to involve exactly the same applications in detail the same values of processing and storage and hence the same shape and size of system In other words you are unlikely to be comparing like with like However there is merit in using such contacts, but at a later stage, as we shall see

How to approach suppliers

The best method and the one which provides the best chance of obtaining the most suitable system for you, is to prepare a tender document and to submit it to a carefully selected *short list* of suppliers

The tender document will be a statement of your data processing requirements, and as such should provide prospective suppliers with an insight into your organisation, its nature of business and the application it is hoped to computerise, together with their related volumes and frequencies It also provides an opportunity to guide the suppliers as to the format and detailed content of their resulting proposals A suggested format for the document is as follows

- Introduction
- Computer Applications
- Suppliers Proposals
- Appendices

Set out in this way, the document should let suppliers know exactly what you want, and also indicate that you fully

Supplier of the introductory Sinclair ZX 80 Clive Sinclair *understand your own needs* and are in a position to evaluate their proposals Let us briefly examine each of the contents as listed

Introduction

This serves as the scene setting section and explains exactly why a computer system is being sought It should also give an outline of your organisation, containing the • nature of your business, • where you are • the size of operation, including turnover and • anticipated growth rates in terms of complexity and volume It will also further serve to explain what type of solution is sought For example an indication that only on-line enquiry is needed rather than a fully interactive on line system could be provided Although this will become apparent later in the report it is well worth setting the scene

It is also worth indicating what sort of supplier arrangement is sought such as – single contract for both hardware and software even though more than one supplier may be involved

Computer Applications

This is the detailed section describing the requirements of *each* of the proposed computer applications This section will relate to the Appendices which contain the volumes and frequencies and so the relevant cross references should be made

The sub-sections one for each application should describe the application for which you require a solution A suitable form is to introduce the application briefly and then list out your specific requirements one by one As an example for payroll the list may include

- production of all payslips
- production of payroll
- coin analysis
- credit transfer schedules
- year-end tax schedules

Supplier of systems including The Communicator David Broad of Comart

Any applications which are only possibilities for the future should be mentioned, but firmly stressed as future enhancements only

You should also mention the proposed order of implementation of the applications so that the most important application to you comes first on the list and not the one which the supplier or suppliers feel is easiest

Suppliers' Proposal

Following the description of your requirements should be the section giving the information that you want suppliers to provide you with in their proposals When you consider how much time and effort has been involved in preparing your report for suppliers information, then you are seeking a similar effort from suppliers to provide you with the right information

The section should ideally list out the headings that cover the groupings of information you need in suppliers' proposals and a request to adhere to the order stated so as to make layout standard and evaluation more straightforward You should also provide details of what you wish to see under each heading

A suggested layout could be

- Introduction and Summary
- Recommended Equipment
- Software
- Support offered
- General, e g references

When evaluating the proposals you should be able to use the references, together with any local uses that you know to validate suppliers claims and get useful users reactions

The level of detail to be expected should if possible be matched to the level of detail in your tender document, the complexity of the requirements and the overall costs involved

Appendices

The appendices contain all the *details* of volumes for each application This involves both frequencies of processing and file storage estimates

The frequencies cover such items as number of orders/day number of invoices produced per week etc and when taken together will indicate the total value of work that the system will need to process depending upon how many tasks are to be processed together

The information for the requirements of file storage is in two parts Firstly, you need to indicate *how many entries* there will be in each file (or records) e g how many stock items how many customers, how many suppliers and so on Secondly you should indicate *how much data* should be kept in each record For a stock item this could include the following description code, bin location, free stock allocated stock stock balance re-order level, order quantity price etc

All this information will enable suppliers to *estimate* your likely storage requirements

Selecting Prospective Suppliers

Having prepared your tender document you now need to draw up a short list of suppliers to whom it should be sent with a request for proposals There is no quick and easy way of doing this but one approach is to set down some essential criteria and then narrow the field down by applying these to the various suppliers Some useful sample criteria could be

- Can the supplier provide an apparently suitable system within my budget?
- Is local hardware and software support available?
- Does the supplier have experience in my specific application areas?
- Have I already had any contact with the supplier?
- Is any supplier's equipment already used in the company?

It is always likely that some subjective and arbitrary selections will be involved especially when using reports of user experience and so forth

In the final stage you want to aim for no more than four or five suppliers This could involve some fairly ruthless selection, but that is your prerogative To go much higher will make the process of evaluating the proposals more unwieldy and difficult and so should be avoided

In conclusion

You should now send your tender document to the selected suppliers with a request for proposals to be returned within about six weeks

The next stage in the process is the evaluation – but more about that later ■

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Anthony Esgate

A SMALL SYSTEM FOR BUSINESS

The Grama Winter Integrated Business Package on the Superbrain

Grama Winter & Superbrain

The number of dealers getting about for the Intertec Superbrain computer is rapidly growing. One such is Grama-Winter in London who after a period with the PET are increasingly putting their eggs in the Superbrain basket.

G W have produced their own Integrated Business System which includes everything from inventory to sales summary. It consists of a 24-program menu–

01 = ENTER NAMES & ADDRESSES
02 = *ENTER/PRINT INVOICES
03 = *ENTER PURCHASES
04 = *ENTER A/C RECEIVABLES
05 = *ENTER A/C PAYABLES
06 = *ENTER UPDATE INVENTORY
07 = ENTER UPDATE ORDERS
08 = *ENTER UPDATE BANKS
09 = *EXAMINE REPORT SALES LEDGER
10 = *EXAMINE REPORT PURCHASE LEDGER
11 = *MONITOR INCOMPLETE RECORDS
12 = *EXAMINE PRODUCT SALES
13 = *PRINT CUSTOMERS STATEMENTS
14 = *PRINT SUPPLIER STATEMENTS
15 = *PRINT AGENT STATEMENTS
16 = *PRINT TAX STATEMENTS
17 = GENERAL HELP
18 = ALTER VOCABULARIES
19 = PRINT YEAR AUDIT

20 = PRINT PROFIT/LOSS A/C
21 = ENDMONTH MAINTENANCE
22 = PRINT CASHFLOW FORECAST
23 = ENTER PAYROLL (NO RELEASE)
24 = EXIT SYSTEM

and database management

The package is particularly easy to operate A master disk is inserted and on closing the drive door Superbrain goes through CP/M (tm), boots MBASIC and loads and runs the integrated package The program occupies only 22K so can be totally held in store and the master disk removed This permits empty disks to be inserted into the dual drives effectively giving the user an extra drive

At the start of a run BUS reads a file VOCAB, from disk which consists of 237 words that can be arbitrarily chosen This facility Winter claims gives his program translatability into French or any other language

According to Mr Winter the package "has the advantage that the user can alter his file structures field names or whatever without being a programmer – it is not on the market for programmers it's for business users "

A user

One user of the G W package is Mr Davis of H N Davis T V Rental an electrical retailer in Mill Hill

Recognising the need to computerise his book-keeping and customer records Mr Davis started reading the popular

computer press and scanning the adverts for a system that matched his pocket. He looked at a number including Dynabyte and Serendipity, but finally settled on the G-W package, initially on the PET after seeing it demonstrated at the Bloomsbury Centre Exhibition.

With the arrival of the more powerful Superbrain system Mr Davis decided to change the PET system for it.

In pre-computerisation days Mr Davis' book keeping system required him to keep a record of all the goods that came into the shop, another of the price he bought them at and yet a third for prices offered to the customer (who should not get an opportunity to find out the cost price) – three sets of handwritten books before even the invoices went up to the accounts department. With the bought ledger that's four sets of books

containing essentially the same information."

Mr Davis commented that, "At the moment we've got stock on disk which means that we can print a buyers list containing all the information we know about our stock. It currently contains about 1000 lines and we can print an extract from that list which serves as our shop list for sales staff to use. They can quote straight to the customer without having access to confidential information. There are two lists we can print—one confidential and one we can show to the customer.

Necessary alterations are marked in on these lists at any time and a completely new printout obtained every month.

At the time of writing, September 1980, Mr Davis was only in his third month of using the Superbrain system and was then occupied in entering an address list for all ledger sheet customers onto another disk. This list contains some six or seven hundred names, addresses, telephones, details of equipment purchased or rented etc. Printout from the address list will eventually be used by the service department – upon receipt of a request for service the service engineer will be sent to precisely the correct address and will know in advance what model the customer has, down to its serial number and age, allowing him to bring the correct spare parts.

"The computer is not yet running the business," Mr Davis remarked that. "We're carrying on the business in the old way at the same time – so we're right in the middle of running two systems in parallel." This is, in fact, the result of lessons Mr Davis learned whilst implementing the PET system. In that case he allowed himself three months to get all the files onto the computer so as to go live on the first day of the last financial year. "We found it very difficult to keep up with the business as well as key it in on the PET," he recalled. "Superbrain is faster and we're not being so ambitious – we're taking our time over it."

The old system consists of ledger cards, the Twinlock Triform system and handwritten manuals. Mr Davis is currently "trying to see how much extra information we can get out of the computer without discontinuing Triform."

Asked when he expects to go over to fully computerised bookkeeping, Mr Davis replied "We're going to run monthly accounts so each month we hope to get better and better until next April when our next financial year begins. We may then be able to switch over to computerised bookkeeping. It takes quite a bit of working up to."

"We're just starting to put in the accounts receivable. Once we get the purchases working we can then start producing supplier statements. If we keep a purchase ledger for the whole of the quarter then our tax statement will be produced automatically."

To date Mr Davis has experienced no hardware problems and, as he has used only a few of the programs from the menu, does not feel in a position to comment from experience on the software. He is aware, though, that parts of the software – payroll and year audit – are still under development.

"At the moment," he concluded, "I'm keeping backup data files on separate disks which I keep on other premises. I think eventually the disks will become more valuable than the hardware. All in all it's been a source of work and we reap the benefits only when we begin to use the data files more." ■

■ *Anthony Esgate is Deputy Editor of Computer Age*

As VDUs become part of office life, more attention is being paid to their possible effects on health

TERMINAL HEALTH

An investigation has recently begun in Canada following the births of four handicapped children. Their mothers had each worked on the visual display units (vdu's) of a Toronto newspaper at some time during their pregnancies. However, no excessive x-rays or microwaves have been detected radiating from the terminals.

Fears and worries accompany changing technology, not without cause. In 'offices of the future', visual display workstations are felt by some to be a threat to jobs and lead to understandable but intangible suspicion for what would have seemed science fiction a few years ago.

VDU's were first used for scientists and researches to turn to occasionally, but not to gaze at for eight hours a day, which might be the workload wanted for word processing. Likewise the cathode ray tube (crt) was developed to generate pictures *not* lines of text. It has been realised that the introduction of vdu's into office life needs planning and many studies have looked at the health hazards of vdu's, and many recommendations have been made on how to overcome some of the problems. What follows mentions the physical complaints of vdu work and reports on some of the studies' findings.

Pain in the neck

Uncomfortable, heavy, dry eyes, which ache, burn or throb are recognised as ocular symptoms, while problems with focusing, double images or colour fringes are visual symptoms of eyestrain. The most common complaints from vdu operators are of head, arm and neck aches.

One piece of research has estimated that 10–15% of vdu workers have almost daily eye trouble of some sort and 40–50% suffer occasionally. These complaints are generally considered to be reversible, lasting perhaps until sleep. Some terminal operators say they avoid watching television after work.

Measurement of eyestrain by, for example, reading rate and comprehension, pupil diameter or blinking, has been unreliable, giving no satisfactory explanation of the causes. The work being done by Ostberg at the University of Lulea in Sweden, concentrating on the refractive power of the eye, may be making ground with the problem. Detectable after-effects of vdu work have been demonstrated using a laser optometer. The technique measures whether the eye is focused for a certain object. If it is, stationary speckles of laser light are seen by the subject under test. If the eye is focused too close, the speckles move in one direction; if too far, they go in the other.

After long and taxing vision, it appears the eye muscles refract too much light when viewing distant objects, and too little for close ones. This is not confined to vdu viewing though, as workers typing or reading in traditional office jobs suffer from aches and pains of eyes, arms, shoulders and neck as well. However, statistics show that the symptoms are not as frequent as they are for vdu users.

Inside the terminal, not all the electrons bombarding the phosphor on the crt screen generate visible light. It is said that most vdu's, with a tube voltage of less than 20kV, produce about 1/100 of the European and US x-ray safety limit. Even working a five day, forty hour week, x-ray exposure is well below the recognised limit and is apparently not a risk. Radio frequency radiation, infra-red and ultra violet are confined to the vicinity of the source, and ultra violet is unlikely to pass through the glass screen.

Recommendations

The Association of Scientific, Technical and Managerial Staff (ASTMS) have published guidelines aimed to keep vdu discomfort to a minimum. Echoing recommendations of other studies, they cover types of text to be displayed on the screen and ways to avoid the distractions of flicker and glare. Their report mentions office furniture, its layout and the frequency of rest periods.

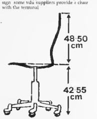
Depending on the degree of background brightness in the office, which will probably be dimmer than staff are used to, the report suggests a minimum screen luminence of 75 cd m^{-2} and background luminance of between 15–20 cd m^{-2}. The contrast between luminance of screen characters and screen background is said to be more important than colour. Reds and bright blues should be avoided, while yellowish green letters on a dark green background is considered a good combination, green being towards the middle of the visible spectrum and thought to be relaxing. Based on a viewing distance of 712mm, the character height should be at least 3.1 to 4.2 mm for a raster scan dot matrix. Too large characters are not necessarily an advantage. A width of 70–80% of character height has also been proposed.

Flicker depends on the persistence of the phosphor and the scan rate of the electron beam. If they are not well matched the text will be unstable. Long persistence phosphors may help, but they are expensive and reduce tube life. A refresh rate of less than 50 Hz may cause discomfort.

Glare is reflection of light from windows and other surfaces near the horizontal plane of the eye. Ambient lighting has been suggested to be not greater than 300 lux and the luminance ratios of vdu, desk and room should not exceed 1:3:10. To avoid reflections, the vdu should be positioned at right angles, not facing windows, and artificial light should be shielded or reflected from walls. Some terminal users have shades around the screen to cut out reflections while some other screens are etched, coated or roughened by the manufacturer.

According to ASTMS the common 'qwerty' keyboard should not be fixed, but be able to move independently of the vdu. It should be positioned as low as possible, with square keys of side between 5–2mm. Keys with a matt finish also reduce glare. The paper 'source documents', perhaps resting on a lectern, the keyboard and the screen should all be the same distance from the eyes.

Ergonomic experts say muscle fatigue is due to constrained postures. At a terminal the operator has little chance to move his head or hands much. To ease the situation, the neck should not be bent forward more than 20° from the rest of the body, shoulders should be relaxed, elbows with an angle of 80°–100° and forearms and hands horizontal; an adjustable chair with a high back and no arm rests is supposed to be the right design; some vdu suppliers provide a chair with the terminal.



Workstation chair

Thirteen percent of Swedish salaried employees daily work at vdu's and Sweden* was the first country to produce national directives on vdu work. These are similar to the ASTMS proposals, although neither are very certain about rest-time periods. ASTMS want mutual planning with managements on work patterns, limiting where possible the creation of a single vdu operator category. They recommend no agreement on work loads before a six-month trial period is completed by the operator. Where vdu

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**The Swedish company Datasaab has published a splendid brochure on the subject. See page 71.*

work is not varied, operators should not work continuously for more than two hours, followed by a thirty minute break There should be a maximum of four hours a day spent at a terminal with more breaks for example 50 minutes vdu work followed by a fifteen minute break

The proposals mentioned so far have been aimed at those vdu operators without any existing sight defects or other medical conditions Epilepsy in many forms affects one in 200 of the population with five percent of epileptics suffering from 'tv' or photosensitive epilepsy It is felt that this five percent should not work at vdu's without medical advice People susceptible to migraine may find added aggravation, and the effect of drugs such as Valium, Librium, or alcohol could add to eyestrain

Those with naturally good or properly corrected eyesight will probably not have any serious eye trouble while working at a terminal However according to the Association of Optical Practitioners, nearly one third of the working population have insufficiently corrected sight defects and will suffer During operator selection eye tests should be made Those who wear reading glasses will probably be out of focus when working at arms length at an almost vertical screen and wearers of bifocals may find neither section of the lens adequate A separate pair of intermediate spectacles solves the problem, but the screen will be out of focus for both long distance sight and

conventional reading Trifocal glasses give long intermediate and reading focusing distances as the lenses have three sectors It has been suggested that the intermediate part should be larger for vdu use

A social problem

Ergonomics has eased some of the problems of eyestrain and fatigue in office life but communicating the findings to those concerned is another hurdle Designers of vdu's need to know all the hazards as do those who choose and buy the equipment and those who work at it There are publications available comparing vdu's and giving advice Adjustable office furniture is a common demand they share, as well as that of each workstation installation being planned individually

Adjustable terminal with a movable keyboard

A former president of the Scottish TUC John Matheson has said that the real national disaster is that too few companies have been able to exploit new technology as quickly or as fully as their international competitors who are now putting them out of business Although there seems to be little disagreement about the physical problems vdu viewers face and on ways to overcome them, arguments arise over the social side-effects Some see a swarm of vdu's sweeping across industry and commerce, laying waste to traditional jobs Some expect an evolution of technology to change office work only gradually You pays your money – or you don't ■

- *James Pentney is a freelance journalist*

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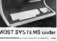

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AN EXTRA PAIR OF HANDS

Part III: The Implications

The author is with Peat Marwick Mitchell

New technology requires new methods. That sounds like a truism – but look at Figure 1.

In the earliest cars, a driver who wanted to show that he was turning right simply held out his arm. When cars acquired roofs and windows, that wasn't so easy. Electrical technology came to the rescue. Electricity moved a mechanical arm, imitating the human arm. The mechanical arm even lit up! It was a neat solution – but it solved the wrong problem. The problem was not "How can I imitate the action of a human arm?", it was "How can I *show* that I want to turn right?" If electricity was to help solve the problem, why not use it to do something it's really good at – flashing a light on and off?

The mechanical arm is only an intermediate stage. New ideas are often derived from existing ones, but while they're held by the mechanical arm they can't make a significant impact. They *need to escape from the existing pattern and establish their own identity*. Early television news had a spoken commentary with still illustrations – radio with pictures. Contrast that with News At Ten, with its live presenters, interviews, filmed reports and graphics. It's very different, and much more effective.

Some people regard a word processor as an advanced typewriter; others think of it as just another computer. Each is held by the mechanical arm. Word processing contains recognisable elements from both typing and computing, but it's developing beyond the confines of both into a new craft. This article explores some of the implications of this development, under the headings

- words and paper
- indexing
- systems and operations management
- discipline, training and control

It then illustrates some of these ideas in a short case study.

Words and paper

A word processor is at its most efficient when using stored text. If you're sending the same letter to 50 customers you can type it once, and let the machine merge it with each name and address.

That assumes that the text of the letter makes sense to each customer. An obvious statement, you might think. But one of the less obvious chores of introducing word processing is the composition of standard text. Consistency is important, especially if you intend to use a library of standard paragraphs to build up various documents. Will you say, "I", "we", "the writer" or "the company"? What will you do about alternatives such as singular and plural, male and female? Figure 2 shows a typical example from a solicitor's office.

Consistent terminology is important too. A building society may write about a borrower's monthly payment – or is it repayment, or instalment, or subscription? It might be a good idea to establish a list of preferred terminology to avoid duplication or confusion.

A streamlined flow of paper is probably the most important technical factor in a successful word processing installation. The printers cost enough, make them work! The ideal is to use continuous stationery wherever possible, either your own stationery printed in continuous form or your single sheets mounted on a continuous backing web. There are also single-sheet hopper feeds available (of variable quality) which you can load with your ordinary stationery.

Unattended printing is the goal to aim for. If you have several jobs to print on the same type of paper, you can load the printer with the required paper and leave it to get on with the job. The typist can then use the screen for typing or revision, keeping both screen and printer busy. This is easier if you can agree to use only a few shapes and sizes of paper with a fixed number of copies (easier said than done).

If you don't have a house style for presenting information on paper, you'd find it useful to develop one. Somewhere in the word processing cycle you'll have to specify margins, tabs, line spacing, and the number of lines on a page. If these are standard for all documents, so much the better. Agreement on the use of capitals, underlining, and the numbering system for reports will also help to save time and present a consistent image in print.

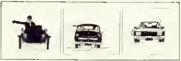


Figure 1. The mechanical arm is only an intermediate stage

Indexing

The essential principle of word processing is *never type anything twice*. But if you're doing to save text to use again, you have to be able to find it. There are three problems:

- what will you store as a unit?
- how will you label those units?
- how will you label your discs?

Defining a unit isn't easy. Is a report with ten chapters one unit or ten? Are twenty short letters twenty units or one? If a long report is revised mainly within chapters, the chapter may be the best unit. If a batch of letters will be printed on one type of paper, the batch may be the best unit. If you intend to print a document, the type of paper is certainly an important factor in defining the unit of storage. Other factors will arise from the content of the job. A typing job is a message – about a subject, from an author, through a typist, to a recipient. Each of these factors could influence your definition of a unit.

Software features may limit your choice. Page-based software (discussed in the previous article) may force you to have a large number of small units. Document based software could make it difficult to find and print small sections within large units.

When you want to label your units, software limitations are more apperent. Some systems automatically give each document a number. You have no choice – you must refer to the document by its number. However, you may be able to store a list of document numbers with a description of each document's contents.

On other systems, you can give each document a reference or name when you type or file it. You may be allowed as many as fifty cherecters or as few as eight for the document name. How you structure the name is a critical part of your systems design. Short names can be more useful than long ones, not only because there's less typing, but also because they force you to think clearly about the purpose of the name – *identification* and *retrieval* of information.

In small companies mnemonics may be acceptable: you can use document names such as 'Exotic Ices Project Report' or 'CJ's memo to RP'. Larger companies will probably find that this strains the imagination too much. One example of a formal system is the structure where W shows that the document is to be stored electronically for a week,
7 is the date on which it is typed,

CJ are the author's initials,
JB are the typist's initials.

What's happening is that electronic storage is making us think clearly about the old problem of filing. It's fairly simple to browse through a filing cabinet for misfiled paper; it's not so easy on disc. I strongly recommend that you devise – and enforce – a clear and simple procedure for naming electronic documents.

Similar comments apply to the naming of floppy discs. An informal approach is fine until the typist leaves. If you use hard discs, there'll be so few that the disc name won't be a serious problem, but the document name will be. You may get some idea of the contents of a floppy from the disc name, but on a hard disc your document may be one among thousands.

One final (obvious?) point on indexing: you'll need the document name printed on the paper document, somewhere, to get back to the electronic version.

Systems and operations management

Choosing equipment may be the end of an investigation, but it's only the start of the real problem – making it work.

"Walk before you run" is a sound maxim. Jobs which require basic editing or simple standard text are useful to start with. If you select jobs which all use the same type of paper you won't have to worry back complications on the printer.

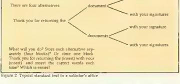
You may find that first attempts at writing standard text aren't wildly successful. So you'll need a procedure for amending them, making sure that each typist has the correct version, and each author knows which is the current version.

Software developments may suggest new applications or easier ways of doing current jobs. You'll need to integrate these into the system, again making sure that everyone knows about them. This brings up the problem of documentation.

Even with one stand-alone machine the authors should have copies of standard text and instructions on its use. In larger installations each author should have a comprehensive procedure manual. This should give instructions on the use of dictation or copy input, standard text formats and paper, and the different periods for which documents will be stored electronically.

It sounds boringly formal, and it is a nuisance keeping it all up to date. But the alternative is chaos. Remember you're trying to combine the computer's logic with the secretary's discretion. If you don't tackle it systematically you'll soon wish you'd never heard of word processing.

Careful scheduling is required to keep screen and printer busy. You can batch work which requires the same type of paper. More sophisticated systems have a facility known as a print queue. This lets you type documents in any order and put them in an electronic queue, with each document tagged to show which paper it requires. When you load a printer with the right paper it will search the queue and select only those documents whose tags match its paper.


Text: Thank you for returning the document(s) with your signature(s)

There are four alternatives

What will you do? Store each alternative separately (four blocks)? Or store one block Thank you for returning the (insert) with your (insert) and insert the correct words each time? Which is easier?

Figure 2 Typical standard text in a solicitor's office

On shared facility or shared logic systems it's common to have the printers at one end of the room to reduce the effect of noise. With typing and printing physically separated, you need someone to control the printing. So you introduce a new element into the typist's job: teamwork between the typists and the print controller. It's no use if a typist sends a job into the print queue and doesn't care what happens next. And if something goes wrong with the printing, both typist and print controller may have to work together to put it right. Several companies with this problem have settled on the same solution: each typist takes a turn as print controller.

After print control the most pressing management problem is disk housekeeping. That doesn't mean dusting the floppies; it means organising documents on disk efficiently. The two main areas are back up copies of live documents and deletion of dead ones.

Back up copies are a familiar feature of data processing. The principle applies to word processing too. At the end of a day copy the contents of each live disk on to another disk. That way you should have at least two copies of everything that's more than a day old. So a cup of coffee spilled over a disk is an irritation, not a disaster. But the procedure is not foolproof. I know of a supervisor who mixed up the covers of her hard disks and wiped out a thousand pages instead of copying them.

A more usual way of deleting work is based on predefined storage periods. My earlier example of a document name (W/7/CJ/JB) included a storage code – W/7. This indicates that the document was typed on the 7th, and is to be stored for a week. On the 14th, every document whose name begins with W/7 can be deleted.

Each typist may be responsible for her own deletions, though it's usual for shared logic systems to have a central facility for mass deletion. On the one system, for example, you can produce a catalogue of all documents whose names begin with W/7 (or any combination you define) and delete them automatically.

Discipline, training and control

I hope I've convinced you by now to approach word processing methodically. The suppliers will show you how to use their machine, but the rest is up to you. (Suppliers' training isn't always adequate. A firm of accountants had a machine for four months without knowing how to produce standard letters: not only had the supplier ignored this subject on his training course, he hadn't even given the customer the program to do it.)

Management, authors and typists all need to be aware of the concepts, as well as the mechanics, of word processing. Loosely structured office procedures don't mix easily with computer logic. But if everyone appreciates the potential benefits, and the strengths and weaknesses of this new office equipment, the changeover should be less traumatic.

There's obviously a need for training. You need to convince authors, for example, that careful preparation is still essential before they commit words to paper. It's a waste of time to have unnecessary redrafts just because the facility's there.

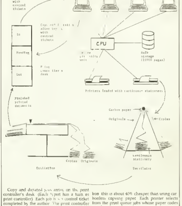
Most suppliers provide training just for the typist. If you want extra training your choice is narrow. There are some new companies who specialise in this subject and some longer-established consultancies who offer this service as part of a wide range.

There's only one organisation in the UK dedicated solely to word processing the International Word Processing Association (IWP). Its purpose is to develop and disseminate word processing ideas, methods and techniques, and to enhance the recognition and professional status of those engaged in word processing. There are branches in Birmingham, Leeds, London and Manchester, with the UK growth co-ordinated by Freda Clark who can be contacted at **01 949 2140**. (A recent newsletter includes what must surely be the authoritative definition of word processing: *a system for getting the jottings of one executive into the filing cabinet of another without going through the minds of either*.)

One subject certain to provoke lively discussion is 'Who should control word processing?' Office services, O & M and the computer department all have an interest. But remember the mechanical arm. Word processing is a new discipline and it needs to develop its own career structures. Experience in the US shows that *this often opens new career opportunities for women*. At last, a spark of light in the darkness of recession!

Case study

A large financial institution had a typing pool of 40 typists serving 500 authors, mainly correspondence clerks. The bulk of the work was letters and standard forms. Original letters were dictated – a thousand a day, average length 20 lines. Many of these were variations on a few themes, suggesting standard paragraphs as a possibility. There are over a hundred varieties of pre printed standard letters and forms. The typists inserted the variable information (supplied by the clerks) in gaps on the pre printed stationery. There were 1500 of these completed daily, with ten lines of variable information on average.


Copy and dictation for typing, with control tickets
Screens
Copy and dictation after typing with control tickets
In
Pending
Out
Print controller's desk
CPU
Central processing unit
Bulk storage (10000 pages)
Printers loaded with continuous stationery
Finished printed documents
Carbon paper
Originals
Copies
Continuous stationery
Copies
Originals
Guillotine
Decollator

Copy and dictated jobs arrive on the print controller's desk. (Each typist has a turn as print controller.) Each job has a control ticket completed by the author. The print controller gives jobs with their control tickets to the typists. When the jobs have been typed, the print controller collects the control tickets with the copy or dictation and leaves them in Pending.

Each typist sends the job to a print queue with a code to identify the paper it should print on. The central processing unit controls the movement of jobs between screens, the bulk storage unit and printers.

The print controller loads the printers with continuous stationery. The stationery is two part fan fold, interleaved with one time carbon; this is about 40% cheaper than using carbonless copying paper. Each printer selects from the print queue jobs whose paper codes match its own.

When the jobs are printed, the print controller takes the stationery to the decollator. This removes the carbon paper and separates the continuous originals from the continuous copies.

She feeds the continuous originals and copies through the guillotine, which cuts them into single sheets. Then she takes the finished printed documents to her desk, where she matches them with the pending control tickets and returns them, with the copy of dictation input, to the authors.

Figure 3 Flow of paper through a shared logic system in a large financial institution

The three main criteria for selecting word processing equipment were:

- large storage capacity (10000 pages available at any one time)
- easy method of building letters from standard blocks;
- bulk deletion of obsolete work.

A small shared logic system was installed in the typing pool, and gradually expanded over two years. The project was co-ordinated by the organisation and methods department. O & M (Organisation and Methods) and the user departments worked jointly to compose standard text.

Users agreed on seven types of continuous stationery, with one original and just one carbon copy. Pre-printed standard letters were gradually withdrawn.

Each electronic document was indexed by a name which showed:

- the date when it was due for deletion;
- the author;
- the typist;
- the type of work.

This index was written on a control ticket which accompanied the document on its journey through the system.

Most documents were short-lived and were deleted after two working days. This gave the author time to return the paper document for amendment if necessary. Standard text and some reference documents were stored permanently.

All printing was controlled centrally, and each typist was responsible for print control in turn. Figure 3 shows the layout of the equipment and the flow of paper.

The first department to use the system had simple standard letters on two types of paper. Every two or three months another department's work was added. Extra screens and printers were plugged into the system when required.

Each department had a one-day training course in company with the typists who would be doing their work. The course explained word processing concepts, benefits and the new procedures for ensuring a smooth flow of work. The final session was in the typing pool, where the typists demonstrated exactly how the authors' work would be done.

This company's approach to word processing has been thoroughly systematic – and it's paid off. Staff turnover in the typing pool has dropped dramatically. The typist's job is more interesting and better paid. The author's work is returned more promptly, and its quality is consistently higher. No-one is out of a job; in fact several people have been promoted. The company is expanding successfully, because it's using new technology with new methods. ■

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Competitive age

I would like to thank all the authors of past articles and yourself for a very interesting and useful magazine. About six months ago I was requested by my school to enter a competition run by the Department of Industry concerning the applications a micro-computer based system could be put to in a comprehensive school. Without a great deal of experience of computers I found *Computer Age* an invaluable source of information. I found the articles on Artificial Intelligence and the Brand News sections particularly useful.

I would also like to take this opportunity to thank the Scientific Centre IBM staff who kindly let me come to the centre and devoted much time to me while I was there.

Recently I have discovered my entry was fortunate enough to be one of the hundred prizewinners and my school will receive a Research Machines micro-computer and hence my letter of thanks to your very enjoyable (and useful) publication.

Fraser Burton, 5 Westhill, Romsey Rd, Winchester, Hants

•Copy of **Living with the Micro** *by Martin Banks*

Generation age

I am a regular reader of your magazine and your unique approach dealing with professional attitudes to microcomputing will ensure that I remain so. However Issue 12 contained an article which disappointed me. After a succession of articles stating the importance of structured/top down program writing, SUMS gave a classic illustration of how not to do it! This was a particular shame as except for the coding, this project does practise what your articles preach. The exact aims and specification of the program had obviously been well thought out, extensions had been anticipated and the dialogue is beautifully user friendly.

On a more practical level may I endorse Dr Morgan's comments on the problems of random number generators and their variable syntax. On my machine the published code would guarantee the identical sequence on every run! There is however a more general solution to getting a random starting point and sequence. Most systems have a keyboard scanning routine allowing input of one character at a time without using a <RETURN>. By using this procedure, the machine may be cycled through its pseudo-random generator *until a response is entered*. For example with a PET the syntax is GET A$. This returns in A$ the value of the key pressed with this instruction is executed. The other construct required is concetenation of strings. Once again using the dialect of Basic found on the PET:

```
4000 A$ = B$ + C$
```

Where B$ = "YE" and C$ = "S" this line returns A$ = "YES".

Line 1190 (Listing, page 28) for instance may then be replaced by –

```
1190 GOSUB 3000   REM INPUT WITH
RANDOM RND CYCLER
3000 A$ = ""   PRINT "?"   REM
INITIALISE A$ TO NULL AND PRINT
PROMPT
3010 GET B$   X = RND (X)   IF B$ = ""
THEN 1190   REM IF NO KEY PRESSED
THEN CYCLE RND AND LOOK AGAIN
3020 PRINT B$   REM ECHO KEY ON
SCREEN
3030 IF ASC(A$) ><13 THEN A$ = A$ +
B$   GOTO 1191   REM UNLESS KEY IS
<RETURN> ADD CHARACTER INTO A$
AND LOOP FOR NEXT
3040 RETURN
```

This subroutine behaves exactly like INPUT B$ as far as the user is concerned but cycles through a very large but variable number of RND steps according to how rapidly the user responds. On different machines to the PET DO check your Basic manual. Variations in syntax are enormous e.g. for GET the TRS-80 uses B$ = INKEY$ and on OSI machines one has to write one's own subroutine but having done so one can detect and separate up to 8 keys pressed at the same time!

The result of this technique is an unpredictable sampling from the pseudo-random sequence which approaches a truly random series. Since the final randomising process is in the picking of which number to use, the randomness of the set of available numbers is not too important. Because of this the technique is easily extended to produce weighted random values. For instance one might want the numbers 1 to 5 with frequency proportional to the size of the values. Set up a 15-element array N(1) to N(15) holding one 1, two 2s, three 3s etc. Replace X = RND (X) in line 3010 with X = X + 1 - INT(X/15). (This generates the numbers 1 2 3 … 14 15 1 2 … in sequence). Finally where the random number is required use N(X). Since X is a number between 1 and 15 inclusive selected at random according to the length of the human response time, the result is a value chosen at random from the array which holds the required values in the required proportions. The randomness results from the very high speed at which the machine steps the sequence – – hundreds or thousands of times a second. Finally combinations of these randomising process can yield almost any variety of random numbers even from a comparatively crude RND ( ) function. The only drawback to the technique is that some user response is needed at each extra randomising step. Even without that however one could try –

```
FOR I = 0 TO Z * RND(X)   RND(X)   NEXT
I
```

where Z contains a random number generated via GET etc at the start of the run.

I hope this is of assistance to those of your readers using pseudo-random numbers.

D R Beaumont, Cliffe House, 43 Cliffe Street, Keighley, Yorks BD21 2ES

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Information age

One small comment on the most interesting article by John Kavanagh on possibilities for computer assisted self teaching in your October issue.

It is the DES (Department of Education and Science) which is the home of the UK Government's four year £9m micro education programme. The Council for Educational Technology is only its office where the day to day administrative work of the Programme will be carried out.

You will know by now that the Director Richard Fothergill of Newcastle Polytechnic is in post. His small staff are currently being appointed.

Jill Coates, Information Officer, Council for Educational Technology, 3 Devonshire Street, London, W1N 2BA

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